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INTEGRATION OF LATEX TIMBER CLONE RUBBER AFFECTS THE OIL PALM YIELD

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ABSTRACT

The dual purpose of latex timber clone (LTC) rubber; i.e. *to produce good quality timber as well as latex yield, had inspired the Malaysian Palm Oil Board (MPOB) to carry out a study on integration of LTC with oil palm. Experiments were conducted to determine the suitability of integrating LTC (RRIM 2024 and RRIM 2025) with oil palm with respect to the effects on the yield of oil palm. The LTC were planted in the double avenue oil palm planting system at two planting densities of 136 palms ha^{-1} and 120 palms ha^{-1}. In each oil palm planting density, LTC was planted at two different densities, 372 trees ha^{-1} and 422 trees ha^{-1}. The advantage of double avenue oil palm planting systems is that the avenues between the palm rows are wider to allow for greater light penetration and better environment for growth of LTC. The study showed that both types of LTC, the RRIM 2024 and RRIM 2025 were growing well under the double avenue oil palm planting system. The rubber trees produced cup lumps and rubber wood log with no difference in the two oil palm planting densities. More importantly, this study found that the integration of LTC has affected the yield of oil palm. The oil palm fresh fruit bunches (FFB) was significantly reduced as early as Year 5 of harvest and continuously decreasing for four consecutive years until the Year 9 of harvest. Current results showed that even though the space between oil palm planting has increased to 18.3 m but the result remains the same. The reduction of oil palm FFB yield could be due to competition for light and nutrient between LTC rubber trees and oil palm. Yield produced from the LTC rubber trees would not be able to compensate losses from FFB yield. Therefore, this study concluded that LTC is not recommended for integration with oil palm in the double avenue oil palm planting system and also in standard triangular planting system.*

Keywords: integration, latex timber clone, oil palm, double avenue planting system, LTC log.

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INTRODUCTION

Rubber, *Hevea brasiliensis* originates from Brazil and had been widely planted in South-east Asia. The rubber tree belongs to the family Euphorbiaceae. It is the most economically important member of the genus *Hevea* because the milky latex extracted from the tree is the primary source of natural rubber. Nowadays, the usage of rubber has become increasingly important in daily life. However, suitable land for rubber cultivation is becoming scarce due to development for industrialisation. Due to the shortage of land, rubber is now being planted in marginal land and attempts are also being made to integrate it with other crops (Joshi *et al*., 2006; Feintrenie *et al.*, 2009; Shafar *et al.*, 2011; Suratman, 2013). Integration also can become a key management strategy to improve biodiversity and ecosystem functions within oil palm production landscape (Ashraf *et al*., 2018).

Latex timber clone (LTC) exhibits good growth and possesses long straight trunks. This clone

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is suitable for the production of latex as well as rubber wood (Malaysian Rubber Board, 2009). The Malaysian Rubber Board (MRB) has introduced seven LTC planting materials for forest replanting programme including the RRIM 2024 and RRIM 2025. These two clones are from the second selection of the RRIM 2000 series, which were classified as Group II clones in the RRIM planting recommendations for 1998-2000 (Chan *et al.*, 2006; Masahuling, 2008; Noordin *et al*., 2012). The first and second RRIM 2000 series clones were classified as 'latex timber clone' producing high latex and timber yield (Lembaga Getah Malaysia Planting Recommendation Committee, 1998). These two clones can produce latex up to between 2685 kg ha^{-1} yr^{-1} and 2700 kg ha^{-1} yr^{-1} and clear bole volume between 0.52 m^3 per tree and 0.63 m^3 per tree (Sawal, 2003a). Nowadays, the usage of rubber has become increasingly important in daily life, *i.e.* as rubber glove, balloons, mattresses, footwear, condoms, *etc*.

In the past, there was no value to the rubber wood except as firewood. As the supply of tropical timber was slowly declined, rubber wood attained some economic value. Since the 1970s, rubber wood had been used for manufacturing wood products, mainly for furniture, and had been accepted as an alternative source of timber for the depleting tropical rainforest species (Ramli *et al.*, 1995). The new-found use of rubber wood is now providing important revenue to the Malaysian economy. From January to May 2013, Malaysia exported about RM 50.4 million worth of rubber wood products and increased to about RM 55.2 million in the same period in 2014. The primary markets of Malaysian rubber wood products are USA, Japan, Singapore, United Arab Emirates, United Kingdom and Germany. The demand for rubber wood logs showed a decreasing trend from 9106 m^3 in January to May 2013 to 6147 m^3 in the same period in 2014 due to slow activities in the market, hence, pulling the price down for most species (Malaysian Timber Industry Board, 2014).

Besides demand, the declining trend in the supply of rubber wood due to reduction in replanting of rubber trees may cause insufficient supply to meet the wood industry. Efforts to increase the rubber wood production have been made including the use of fast growing clones and high-density planting of rubber wood trees (Naji *et al.*, 2012). In practice, several smallholders have conducted the integration of rubber trees without proper design and management (Manivong and Cramb, 2008). Instability in the price of palm oil had inspired MPOB to carry out a study on integration of LTC with oil palm. LTC becomes a safeguard for oil palm grower during the low palm oil price. It also can improve their socio-economy and income especially for smallholders. The oil palm planting system needs to be improved to minimise light and space competition between oil palm and LTC. The oil palm were planted using double avenues and conventional triangular oil palm planting system for control plots. The LTC trees were planted simultaneously with oil palm, so that the LTC's latex can be harvested concurrently with harvesting of oil palm fresh fruit bunches (FFB). The objectives of this study are to determine the growth performance of LTC integrated in two oil palm planting systems and to evaluate the impact of planting LTC on the production of oil palm FFB.

MATERIAL AND METHODS

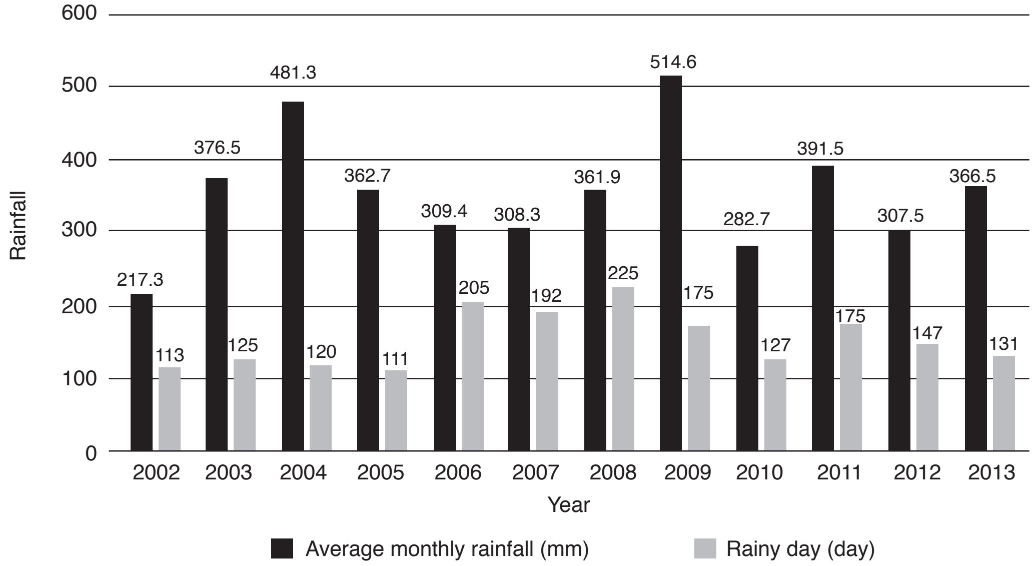
Study Site

This study was conducted at the MPOB Research Station in Hulu Paka, Terengganu, Malaysia. The experimental plots were located in Phase 5 planting block, covering 20 ha of oil palm replanted in July 2002. The area falls between 103°15'52.941"E latitude and 4°38'20.645"N longitude with the altitude of 34.56 m above the sea level. The soil series belongs to a member of Bungor family which is fine, kaolinitic, isohyperthermic, red-yellow Tipik Lutualemkuts which developed over mixed sedimentary rocks. It is characterised by dark greyish brown with fine sandy loam textures (Paramananthan, 2000).

Figure 1 shows the average monthly rainfall and total number of rainy days in the study site. Based on monthly rainfall in each year, heavy rainfall was commonly recorded in November until December and it continued in the following year up to January and February. The average monthly rainfall was more than 217.3 mm. The highest rainfall was commonly recorded between November and January each year ranging from 427 mm per month to 759 mm per month. Dry season was between June and September ranging from 213 mm per month and 337 mm per month (recorded at the Weather Station Site in MPOB Hulu Paka Station, Terengganu). The temperature ranged between 32°C and 34°C throughout the year (Meteorology Department of Malaysia, 2014). This weather pattern could affect some of the activities in LTC integration plots, especially the rubber tapping and harvesting of oil palm. Consequently, it also may affect the yield of oil palm and cup lumps of LTC.

Planting of Oil Palm and Latex Timber Clones

Two double avenue oil palm planting systems were used for field trials on integration of LTC with oil palm (*Figure 2*). Two planting densities of oil palm and LTC were tested. Oil palm was planted at 136 palms ha^{-1} and 120 palms ha^{-1}, while LTC was planted at 422 trees ha^{-1} and 372 trees ha^{-1}. There



Source: Recorded at Weather Station Site in MPOB Hulu Paka Station, Terengganu.

Figure 1. Average monthly rainfall dan number of rainy day at MPOB Research Station, Hulu Paka, Terengganu, Malaysia from 2002 to 2013.

were three control plots in this study, where the oil palm was planted without LTC. The control plots 1 and 2, oil palm was planted in double avenue planting system at planting density 136 palms ha^{-1} and 120 palms ha^{-1}, respectively. The control plot 3, the oil palm was planted using normal triangular planting system at planting density of 136 palms ha^{-1}. The advantage of double avenue planting system is that the avenues between the palm rows are wider to allow perennial trees such as rubber to be planted with oil palm. Different double avenue oil palm planting systems will provide different planting densities of LTC and oil palm or available area for integration (*Figure 3*). Each treatment was replicated three times. The planting of oil palm was conducted in July 2002, while the LTC was planted in October 2002 (*Table 1*). Planting materials for LTC were provided by the Rubber Research Institute of Malaysia (RRIM) at Sungai Buloh, Selangor, Malaysia. The layout of field planting systems for both oil palm and LTC are shown in *Figure 2*.

Fertiliser Application

Fertiliser programme for oil palm was applied based on the recommendation for Malaysian soils which was MPOB F1 (10 N: 5.4 P_2O_5: 16.2 K_2O: 2.7 MgO: 0.5 B_2O_3) at 9.0 kg palm^{-1} yr^{-1}. It was applied three rounds a year with the rate of 3.0 kg per palm with the interval of four months per round using broadcasting technique (Esnan *et al.*, 2002; Tarmizi, 2000).

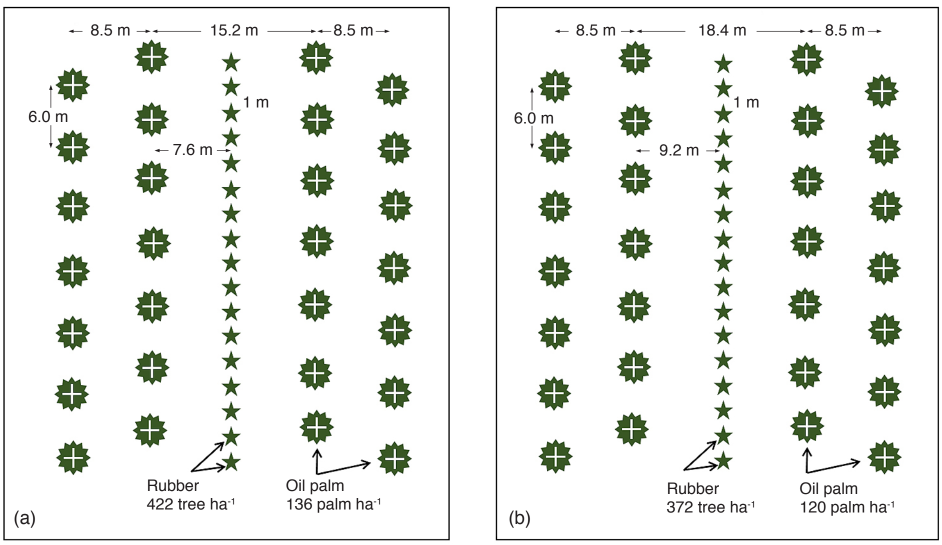


Figure 2. Field layout of integration of latex timber clone (LTC) planted in double avenue oil palm planting system, 136 palms ha^{-1} (a) and LTC planted in double avenue oil palm planting system, 120 palms ha^{-1} (b).

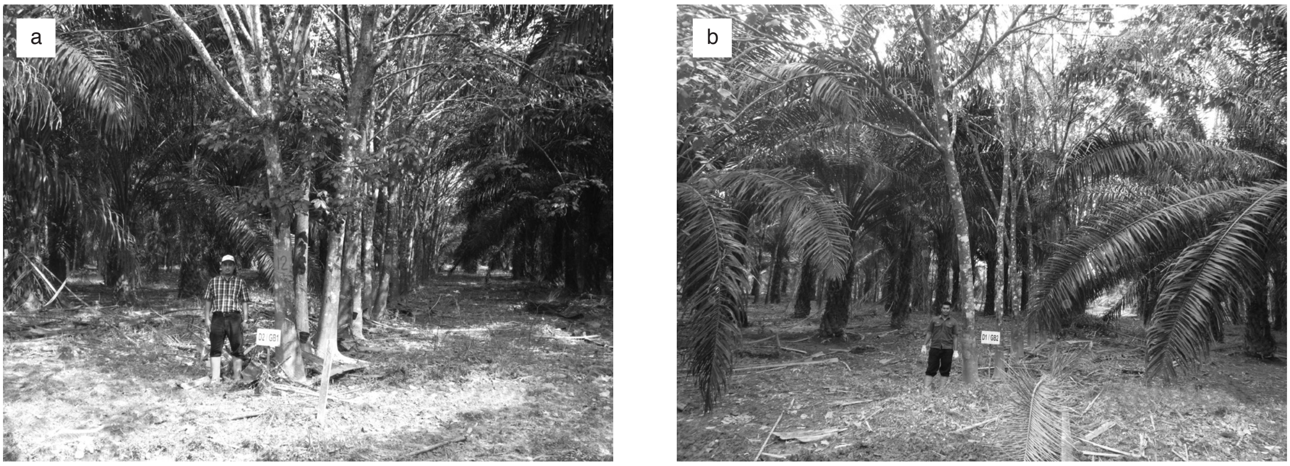


Figure 3. Two types of latex timber clones at 10 years after planting in double avenue oil palm planting system at MPOB Station in Hulu Paka, Terengganu, Malaysia. (a) RRIM 2024 and (b) RRIM 2025.

TABLE 1. DETAILED INFORMATION ON TREATMENTS AND CONTROL USED IN THE STUDY

Oil palm planting system	Type of latex timber clone (LTC)	Density per hectare by integration	
		Oil palm (palms ha^{-1})	LTC (trees ha^{-1})
Double Avenue – 1	RRIM 2024	136	422
	RRIM 2025	136	42
Double Avenue – 2	RRIM 2024	120	372
	RRIM 2025	120	37
Control – 1 (double avenue - 1)	None	136	None
Control – 2 (double avenue - 2)	None	120	None
Control – 3 (normal triangular)	None	136	None

The fertiliser programme for LTC was referred to MRB. At planting, 120 g of rock phosphate was applied per planting hole. Compound fertiliser was used during the early stage of growth; rubber required an equal amount of NPK. The rate of compound fertiliser application and number of round was 400 to 600 g per tree with three rounds per year respectively. The fertiliser used was NPK Green (15 N: 15 P_2O_5: 15 K_2O). After two years onward, the same fertiliser was applied. During the first two years, fertiliser was applied around the tree base, but thereafter it was spread along the planting strip and between rows of trees (Mohd Nasaruddin, 2005).

Data Collection

Census to monitor the survival rate of the LTC trees was conducted each year starting from first to 12 years after planting. The bark thickness and trunk diameter of LTC trees were measured at every six months intervals up to ninth-year after planting. The measurements of various parameters were taken at breast height of about 1.3 m above the ground. The trunk diameter was measured using a measuring tape and bark thickness was measured using a thickness gauge following the recommendation by Forest Research Institute of Malaysia. For each determined parameter, data was recorded from 10 marked LTC trees in each plot. Yield of oil palm FFB was recorded at every harvesting round of two weeks intervals.

The total volume of LTC log per tree was recorded at 7, 9 and 11 years after planting. A total of 10 LTC trees were randomly selected from each treatment plot. The volume of the harvested log was determined by measuring the trunk diameter in every single metre until the first main branch of LTC tree. Then, the total volume of log per tree was obtained based on the total volume of every single metre determined.

Data Analysis

All collected data in this study was statistically analysed for analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) for mean comparison at the probability of P≤0.05 using SAS with version 9.4 (SAS Institute, Inc. Cary NC., USA).

RESULTS AND DISCUSSION

Survival Rate of LTC

ANOVA was performed to determine the effects of different oil planting systems on the survival rate of LTC RRIM 2024 and RRIM 2025 up to 12 years after planting in two oil palm densities (*Table 2*). The survival rate of LTC decreased in the second-year after planting at both oil palm planting density of 136 palms ha^{-1} and double avenue oil palm planting, 120 palms ha^{-1} but not significantly different ($P \leq 0.05$) in all the treatments (*Table 2*). The lowest survival rate was recorded in Year 2 (2003) in plot planted in double avenue at density 136 palms ha^{-1} with LTC RRIM 2025 at density 442 trees ha^{-1} with the value of 28.78% but not significantly different to others. In Year 3 (2004), all dead LTC trees were resupplied and thereafter the survival rate of LTC was maintained at the satisfactory level between 45% to 50% up to year 12 (2013).

Trunk Circumference and Bark Thickness

Table 3 shows the effects of double avenue oil palm planting at planting density of 136 palms ha^{-1} and 120 palms ha^{-1} on LTC's trunk circumference and bark thickness at nine years after planting. The circumference was measured starting from three years until nine years after planting. The data analysis showed that the trunk circumference was higher in the treatment DA1LTC2 with the value of 65.65 cm and significantly higher ($P \leq 0.05$) as compared to other treatments. The trunk circumference for LTC in plots planted in double avenue at density of 136 palms ha^{-1} with LTC RRIM 2025 and RRIM 2024 at density 422 trees ha^{-1} and plot planted in double avenue at density 120 palms ha^{-1} with LTC RRIM 2024 at density 372 trees ha^{-1} was not significantly different (*Table 3*).

The data showed that the growth of RRIM 2024 was not affected, when it was planted in double avenue system at oil palm planting density of 120

TABLE 2. THE SURVIVAL RATE OF LATEX TIMBER CLONES IN TWO DIFFERENT DOUBLE AVENUE OIL PALM PLANTING SYSTEMS

Crop mix planting system	No. of oil palm per hectare	No. of LTC per hectare	Survival rate (%) of LTC at year after planting					
			Year 2 (2003)	Year 4 (2005)	Year 6 (2007)	Year 8 (2009)	Year 10 (2011)	Year 12 (2013)
Oil palm (DA - 1) + LTC (RRIM 2024)	136	442	33.22a	83.35a	70.38a	68.27a	58.75a	45.84a
Oil palm (DA - 1) + LTC (RRIM 2025)	136	442	28.78a	78.48a	67.45a	67.45a	58.93a	50.31a
Oil palm (DA - 2) + LTC (RRIM 2024)	120	372	31.50a	79.46a	71.20a	69.51a	61.15a	54.69a
Oil palm (DA - 2) + LTC (RRIM 2025)	120	372	46.09a	92.58a	81.51a	79.72a	64.72a	54.33a

Note: Mean in columns with the same alphabets are not significantly different ($P \leq 0.05$) after Duncan's Multiple Range Test.
DA - 1 - double avenue oil palm planting system, 136 palms ha^{-1}.
DA - 2 - double avenue oil palm planting system, 120 palms ha^{-1}.
LTC - latex timber clone.

TABLE 3. TRUNK CIRCUMFERENCE AND BARK THICKNESS OF LATEX TIMBER CLONES INTEGRATED IN TWO DIFFERENT DOUBLE AVENUE OIL PALM PLANTING SYSTEMS AT NINE YEARS AFTER PLANTING

Crop mix planting system	No. of oil palm per hectare	No. of LTC per hectare	Trunk circumference (cm)	Bark thickness (mm)
Oil palm (DA - 1) + LTC (RRIM 2024)	136	442	61.63b	8.81a
Oil palm (DA - 1) + LTC (RRIM 2025)	136	442	60.57b	8.97a
Oil palm (DA - 2) + LTC (RRIM 2024)	120	372	59.45b	8.77a
Oil palm (DA - 2) + LTC (RRIM 2025)	120	372	65.65a	8.91a

Note: Means in columns with the same alphabet are not significantly different ($P \leq 0.05$) after Duncan's Multiple Range Test.
DA - 1 - double avenue oil palm planting system, 136 palms ha^{-1}.
DA - 2 - double avenue oil palm planting system, 120 palms ha^{-1}.
LTC - latex timber clone.

palms ha^{-1} or 136 palms ha^{-1}. Krishan (2015) quoted that the trunk size for both rubber clones, RRIM 600 and RRII 105 had attained a tappable girth of 49.97 cm and 48.97 cm respectively, after nine years of planting. In terms of tree height, canopy height, canopy breath, branching height and number of branches, RRIM 600 recorded superiority for all traits as, tree height (9.75 m), canopy height (7.38 m), canopy breadth (5.40 m), branching height (2.59 m) and number of branches (7.80) respectively. The results showed that trunk size at nine years after planting for RRIM 2024 and RRIM 2025 was comparable to both clones of RRIM 600 and RRII 105.

Data analysis on effects of oil palm planting density on bark thickness is shown in *Table 3*. Based on the result, the bark thickness of LTC planted in both oil palm planting systems was not significantly different (P≤0.05) between treatments. At nine years after planting, the bark thickness of LTC ranged from 8.81 mm to 8.97 mm.

Latex Production

Table 4 shows the cup lumps yield in five years tapping of LTC integrated with oil palm in double avenue system at oil palm planting density of 120 palms ha^{-1} and 136 palms ha^{-1}. Tapping of LTC was started only at seven years after planting following the standard practice requiring that 70% of LTC trees have achieved 45 cm in trunk circumference. Manual tapping was done two times a week following the recommendation of the MRB.

Statistical analysis showed that in general, planting of both types of LTC in two oil palm planting densities did not affect the production of latex. Data analysed showed that there was no significant different (P≤0.05) on cup lumps yield starting from Year 1 up to Year 5 tapping for all treatments, except in Year 3 tapping where the cup lumps yield for plot planted using double avenue at density 136 palms ha^{-1} with LTC RRIM 2025 at density 422 trees ha^{-1} was the highest (1.83 t ha^{-1} yr^{-1}) compared to the other treatments.

However, the latex yield seemed to be reducing when the trees become older. Our results showed that the cup lumps yield was decreasing starting from Year 2 up to Year 5 tapping even though the yield was not significantly different among treatments. The same reducing trend in latex yield was also recorded for LTC clone series of RRIM 2000 in the RRIM experimental plots (Sawal, 2003b).

Log Volume of Latex Timber Clone

Previous study showed that log volume of LTC RRIM 2000 series planted in standard monoculture technique recorded higher yield, ranging from 0.33 m^3 per tree to 0.66 m^3 per tree at 14 years old (Sawal, 2003c). In this study, the log volume of both LTC clones integrated in double avenue oil palm planting was shown in *Table 5*. The ANOVA analysis showed that there was no significant difference (P≤0.05) on log volume for both types of LTC recorded in Year 7, Year 9 and Year 11 of harvest. The log volume of both LTC clones showed increasing trend with age. The log volume of LTC RRIM 2024 planted in136 palms ha^{-1} showed the highest value of 0.1867 m^3 per tree in Year 11, compared to other treatments even though there was no significant difference (*Table 5*). Integration of both series of LTC in oil palm produced low log volume compared to monoculture techniques as reported by Sawal (2005).

Oil Palm Yield

The production of the oil palm FFB in the LTC plots was recorded starting from the Year 1

TABLE 4. CUP LUM YIELD OF LATEX TIMBER CLONES INTEGRATED IN TWO DIFFERENT DOUBLE AVENUE OIL PALM PLANTING SYSTEMS

Crop mix planting system	No. of oil palm per hectare	No. of LTC per hectare	Cup lumps yield of LTC (t ha^{-1} yr^{-1}) at year of tapping				
			Year 1 (2009/2010)	Year 2 (2010/2011)	Year 3 (2011/2012)	Year 4 (2012/2013)	Year 5 (2013/2014)
Oil palm (DA - 1) + LTC (RRIM 2024)	136	442	3.9133a	1.9767a	1.3100b	1.07000a	0.8933a
Oil palm (DA - 1) + LTC (RRIM 2025)	136	442	4.0800a	2.2800a	1.8300a	1.01667a	0.8867a
Oil palm (DA - 2) + LTC (RRIM 2024)	120	372	3.5400a	2.0667a	1.5267ab	0.96000a	0.7133a
Oil palm (DA - 2) + LTC (RRIM 2025)	120	372	3.8433a	2.0367a	1.6367a	0.94667a	0.7500a

Note: Means in columns with the same alphabet are not significantly different (P≤0.05) after Duncan's Multiple Range Test.
DA - 1 - double avenue oil palm planting system, 136 palms ha^{-1}.
DA - 2 - double avenue oil palm planting system, 120 palms ha^{-1}.
LTC - latex timber clone.

TABLE 5. LOG VOLUME OF LATEX TIMBER CLONE INTEGRATED IN TWO DIFFERENT DOUBLE AVENUE OIL PALM PLANTING SYSTEMS

Crop mix planting system	No. of oil palm per hectare	No. of LTC per hectare	Log volume of LTC (m^3 per tree) at year of harvest		
			Year 7	Year 9	Year 11
Oil palm (DA - 1) + LTC (RRIM 2024)	136	442	0.11737a	0.17032a	0.18670a
Oil palm (DA - 1) + LTC (RRIM 2025)	136	442	0.10595a	0.13077b	0.18125a
Oil palm (DA - 2) + LTC (RRIM 2024)	120	372	0.11064a	0.15367ab	0.16797a
Oil palm (DA - 2) + LTC (RRIM 2025)	120	372	0.12017a	0.15494 ab	0.18395a

Note: Means in columns with the same alphabet are not significantly different ($P \leq 0.05$) after Duncan's Multiple Range Test.
DA - 1 - double avenue oil palm planting system, 136 palms ha^{-1}.
DA - 2 - double avenue oil palm planting system, 120 palms ha^{-1}.
LTC - latex timber clone.

(2004/2005) until Year 9 (2012/2013) of harvest (*Table 6*). The study showed that there was a significant difference in FFB yield for oil palm planted with LTC as compared to all three control plots, especially after the Year 5 of harvest. In the first four years of harvest, there was increasing trend in the yields of FFB in all treated and control plots. At this period, palm in plot planted using double avenue at density of 120 palms ha^{-1} with LTC RRIM 2025 at density of 372 trees ha^{-1} recorded the highest FFB yield of 3.12 t ha^{-1} yr^{-1} in Year 1 and Year 2 (9.88 t ha^{-1} yr^{-1}) of harvest. In Year 3, palm in plot planted using double avenue at density 136 palms ha^{-1} with LTC RRIM 2024 at density 422 trees ha^{-1} produced the highest FFB yield of 13.20 t ha^{-1} yr^{-1} (*Table 6*).

At Year 5 of harvest, the oil palm FFB yield pattern was clearly changed, where the FFB yield of palm integrated with LTC started to decrease significantly lower than the control plots, until Year 9 of harvest. The FFB yield in all three control plots were consistently increased until the ninth year of harvest. At this Year 9 harvest, the FFB yield in the control plots ranged between 14.64 t ha^{-1} yr^{-1} and 16.15 t ha^{-1} yr^{-1}. However, the FFB yield of palm planted in the LTC plots showed a rapidly decreasing trend for four consecutive years starting from fourth- up to ninth-year of harvest (*Table 6*). The FFB yield of palm planted in LTC plots ranged only between 4.01 t ha^{-1} yr^{-1} and 6.36 t ha^{-1} yr^{-1}. This rapid reduction in oil palm yield could be due to competition for light and nutrient between LTC rubber trees and oil palm. Jalani *et al*. (2002) reported that the average of potential FFB yield for oil palm planted in the inland soil was 22.0 t ha^{-1} yr^{-1} at the age of 6 to 10 years after planting. The result of this study showed that FFB yield in integrated plots was far below the average potential FFB yield of oil palm planted in the same type of soil.

CONCLUSION

The study found that the LTC RRIM 2024 and RRIM 2025 were growing satisfactorily under the double avenue oil palm planting system. The survival of rubber trees was slightly reduced in the early stage of planting to about 28.78%, but after resupplying the dead trees, the survival rate was maintained between 45% to 50% up to 12 years after planting. Tapping of latex was initiated at seven years after planting and there was no difference in the yield of cup lumps for both rubber clones in the two oil palm planting densities. Generally, the latex yield seemed to be reducing when the rubber trees become older. The log volume of both types of LTC harvested in both oil palm planting density plots from seven to 11 years after planting showed no difference. The log volume of both LTC clones showed increasing trend with age. However, integration of LTC in oil palm produced lower log volume as compared to monoculture techniques of rubber tree planting.

The integration of LTC with oil palm affected the production of oil palm FFB. The yield of oil palm planted with the LTC was significantly lower than the control plots, starting from Year 5 of harvest or at ninth year after planting. The decreasing trend of FFB yield continued for four consecutive years up to the end of experiment at Year 9 harvest. Reduction in oil palm yield could be due to competition for light and nutrients between LTC rubber trees and oil palm in the same plots. It was estimated that based on revenue from the selling of FFB, the loss due to reduction of FFB yield would not be compensated from the income generated from the selling of latex cup lumps and LTC logs. Therefore, this study concluded that the LTC rubber trees are not recommended to be integrated with oil palm even in the double avenue oil palm planting system.

TABLE 6. THE EFFECTS OF LATEX TIMBER CLONE INTEGRATION IN TWO DIFFERENT DOUBLE AVENUE OIL PALM PLANTING SYSTEMS ON THE PRODUCTION OF OIL PALM FRESH FRUIT BUNCHES

Oil palm planting system	Type of LTC	Density/ha by integration		Oil palm yield (t ha^{-1} yr^{-1}) at year of harvest								
		Oil palm (palms ha^{-1})	LTC (tree ha^{-1})	Year 1 (Dec. 04/ Nov. 05)	Year 2 (Dec. 05/ Nov. 06)	Year 3 (Dec. 06/ Nov. 07)	Year 4 (Dec. 07/ Nov. 08)	Year 5 (Dec. 08/ Nov. 09)	Year 6 (Dec. 08/ Nov. 10)	Year 7 (Dec. 10/ Nov. 11)	Year 8 (Dec. 11/ Nov. 12)	Year 9 (Dec. 12/ Nov. 13)
DA - 1	RRIM2024	136	422	2.7321ab	8.409ab	13.200a	12.301b	13.339bc	11.886b	7.164cd	8.292b	5.858b
DA - 1	RRIM2025	136	422	2.33.27bc	9.191a	11.575ab	14.015ab	10.956c	8.914b	5.438d	7.196b	4.012b
DA - 2	RRIM2024	120	372	2.1909bc	9.194a	11.394ab	14.673ab	14.607b	11.020b	8.930c	8.848b	6.366b
DA - 2	RRIM2025	120	372	3.1200a	9.886a	12.633a	12.618b	13.815bc	9.788b	7.383cd	9.976b	7.045b
Control - 1 (DA - 1)	None	136	None	2.5847ab	6.128b	7.809c	14.141ab	18.160a	18.404a	20.631d	19.686a	15.421a
Control - 2 (DA - 2)	None	120	None	1.6875c	7.306ab	9.562bc	16.021a	18.311a	15.958a	17.037b	18.534a	16.153a
Control - 3 (N)	None	136	None	1.8651c	6.467b	11.533ab	13.468ab	19.301a	19.203a	18.163ab	21.364a	14.643a

Note: Means in columns with the same letters are not significantly different ($P \leq 0.05$) after Duncan's Multiple Range Test.
DA - 1 - double avenue oil palm planting system, 136 palms ha^{-1}.
DA - 2 - double avenue oil palm planting system, 120 palms ha^{-1}.
LTC - latex timber clone.
N – normal triangular oil palm planting system, 136 palms ha^{-1}.

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