EFFECT OF MULCHING AND FERTILIZER RATES ON THE GROWTH OF RRIM 3001

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ABSTRACT

The major issues and challenges faced by Malaysia recently were declining rubber planted area. In 1990, the total area was 1.837 million hectares compared to 1.078 million hectares in 2015, which is 41% lower than 2015's figure. With the decline in total planted area, government policy has been formulated to meet the requirement of the downstream sector. There are five strategies that have been identified, namely to increase planting area by 40,000 hectares per year, to expand rubber area by new planting 20,000 hectares per year, to accelerate replanting by high yielding clones, promote the mechanization and automation and enhance adoption in the latest technology in latex harvesting. The experiment was implemented at Ladang Komoditi, Jasin, Melaka. This study consists of high productive rubber clone, RRIM 3001 also known as "Klon 1 Malaysia" treated with five levels of fertilizer rates, T1 (0 g/tree per year plus no mulching), T2 (480 g/tree per year plus no mulching), T3 (720 g/tree per year plus no mulching), T4 (480 g/tree per year plus mulching) and T5 (720 g/tree per year plus mulching) by applying the NPK Yellow fertilizer (15:15:6:4) at three months' intervals for a period of one year. One type of mulching system had been practiced namely Ecomat, processed oil palm fibre material (Ecofibre Bhd Malaysia) and the size of ecomat is 1.0 m x 1.0 m x 9mm. The experimental set up was a completely randomized block design (RCBD) with three replications. The study duration was one year period. From the result in this experiment, the fertilizer treatment of T5 (720 g/tree per year plus mulching) showed the best performance in term of height and girth measurement compared to the other treatments.

Keywords: Mulching, RRIM 3001, Batang Merbau, growth

Introduction

Establishment and growth of *Hevea* can be adversely affected by the presence of inherent soil limitations. If a soil has poor fertility due to inadequate nutrients, then such a limitation can be overcome by proper fertilizer application. However, physical limitations are less amenable to alterations. Some of the soil physical conditions that have severe limitations to *Hevea* include water-logging, sandy and structure less soils due to the occurrence of shallow laterite or rock layers. Basically, for a soil to support good growth of *Hevea*, it must have a balanced distribution of the solid, liquid and gaseous phases. This is the reason why favourable growth of any crop is related to good soil structure, since the structure is a manifestation of the state of the three soil phases (Zainol, 1998). When forests are cleared for agriculture, changes detrimental to the environment can largely occur due to alterations in the hydrological cycle, micro-climate, biological populations and soil physical properties (Samarappulli et. al., 1999). Mulching increases and conserves moisture in the soil and also encourages more prolific root development (Pushparajah and Yew, 1977). In agricultural practice, mulching now includes the application of any of a variety of materials to the surface of the soil around the stem of the growing plant, with a view to improving conditions for the root. Mulching can benefit soil conditions in a variety of ways. Mulch protects the soil from extreme temperature; in temperate climates marketable garden crops are thus protected from frost in order to force early growth. An example of the practice to reduce soil erosion is mulching, extensively employed after the harvest in dry land farming. Mulching affords an important means of conserving water, not only by evaporation but also by improving the permeability of the soil surface to rain; it is used with tropical crops such as coffee and sugar cane to ameliorate drought. A layer of mulch will also suppress weeds. Mulching is mostly carried out during the first twelve months of growth; after this period rubber roots should be exploiting large area of soil and so should be less sensitive to drought. Increase in girth size of young trees has been shown during mulching (Rubber Research Institute of Malaysia, 1956). Batang Merbau Series is a member of the clayey, kaolinitic, isohyperthermic, family of the Typic Paleudults. Yellowish brown (10YR 5/4 5/6 5/8) to brown (10YR 5/2, 5/4), sub angular blocky, fine to coarse in size, friable, deep, well-drained, CEC less than 5 Cmol kg clay, low base saturation.

MATERIALS AND METHODS

This study was conducted at Ladang Komoditi, Lembah Beruk, Jasin, Melaka. The study consists of high productive rubber clone, RRIM 3001 also known as "Klon 1 Malaysia" treated with different levels of fertilizer rates and mulching practice. The fertilizer rates were divided into five treatments, T1 (0 g/tree per year), T2 (480 g/tree per year), T3 (720 g/tree per year), T4 (480 g/tree per year plus mulching) and T5 (720 g/tree per year plus mulching) by applying the NPK Yellow fertilizer (15:15:6:4) at three months intervals for a period of one year. NPK Yellow fertilizer (15:15:6:4) was applied at the second month after planting on the ground. Details of fertilization programme used in this study are simplified as shown in Table 1.

Table 1. Total fertilization rate in Ladang Komoditi

Treatment	(g/tree per year)
T1 (No fertilizer + Non Mulching)	0
T2 (Recommended rate + Non Mulching)	480
T3 (Extra 50% of recommended rate + Non Mulching)	720

T4 (Recommended rate + Mulching)	480
T5 (Extra 50% or recommended rate + Mulching)	720

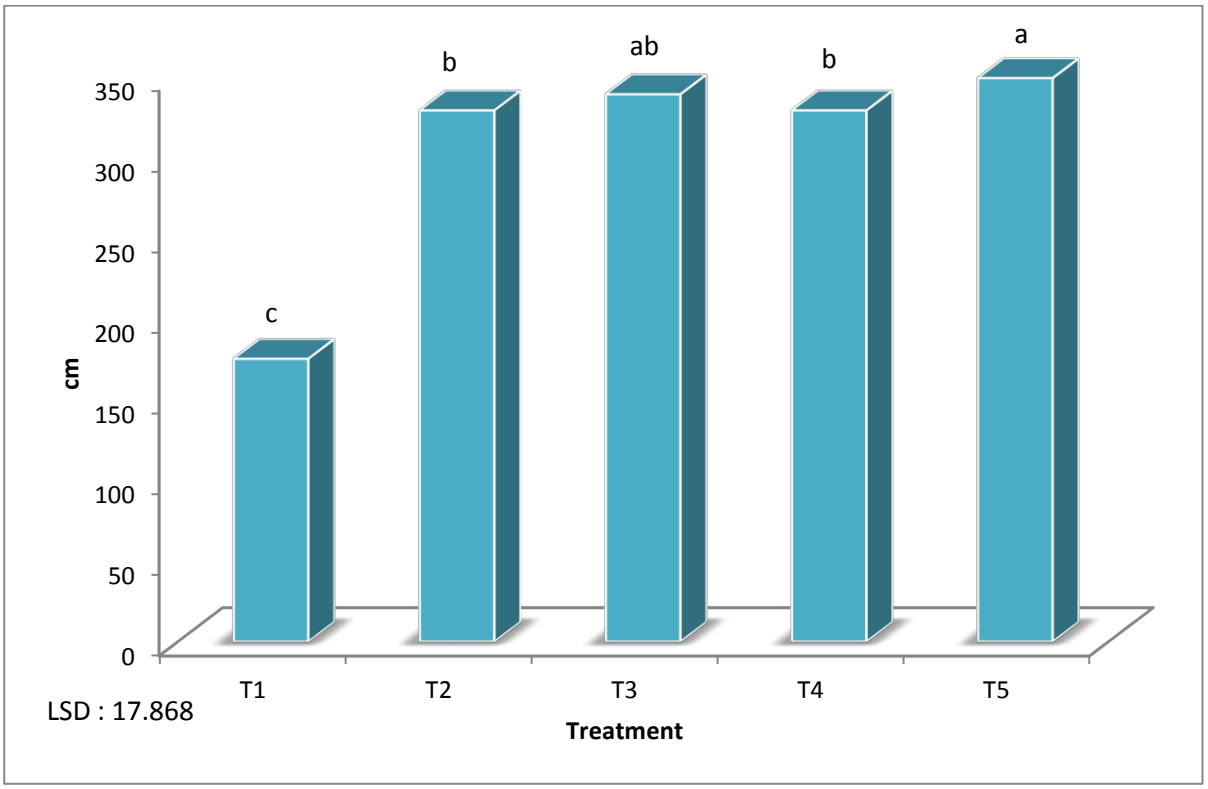
The experiment used randomize completely block design (RCBD) with three replications. The study duration was one year. Data on growth such as plant height, girth and chlorophyll content were taken and analysed for nutritional status at the end of this study. For pedological study, soil sample was collected from each horizon at short depth intervals of soil profile. For chlorophyll content, data was taken using chlorophyll meter SPAD-502. It was calibrated by pressing the measuring head closed without inserting the leaf. For foliar analysis, the leaf samples were dried in a glass bottle overnight at temperature 100°C. The samples were covered with the glass bottle and put into desiccator for 1 hour at room temperature. 1 gram is weighted and put into silica disk. Then, they were ignited in an electrical furnace for 5 hours at temperature 550°C. 1 ml of HCl is added into the sample and dry for 2 hours at temperature 200°C by using hotplate. Then, 4 ml of 20% HNO_3 is added into silica disk and covered with glass and dried for 1 hour at temperature 100°C. The sample is decanted into 50 ml volumetric flask by using filter paper no. 2 with hot boiling water. The solution is made up to 50 ml and ready to further analysis.

RESULTS

Total Plant Height

Total plant height of RRIM 3001 planted in Batang Merbau series based on different treatments as shown in Figure 1. There was significant difference between treatments in term of plant height (cm). The treatment T5 showed the highest (349 cm), followed by T2 and T4 (329.7 cm = 329.3 cm) and T1 (174.7 cm) based on ANOVA and LSD Test at the probability ($P<0.05$).

Figure 1: Height of RRIM 3001 based on different treatments in Batang Merbau series



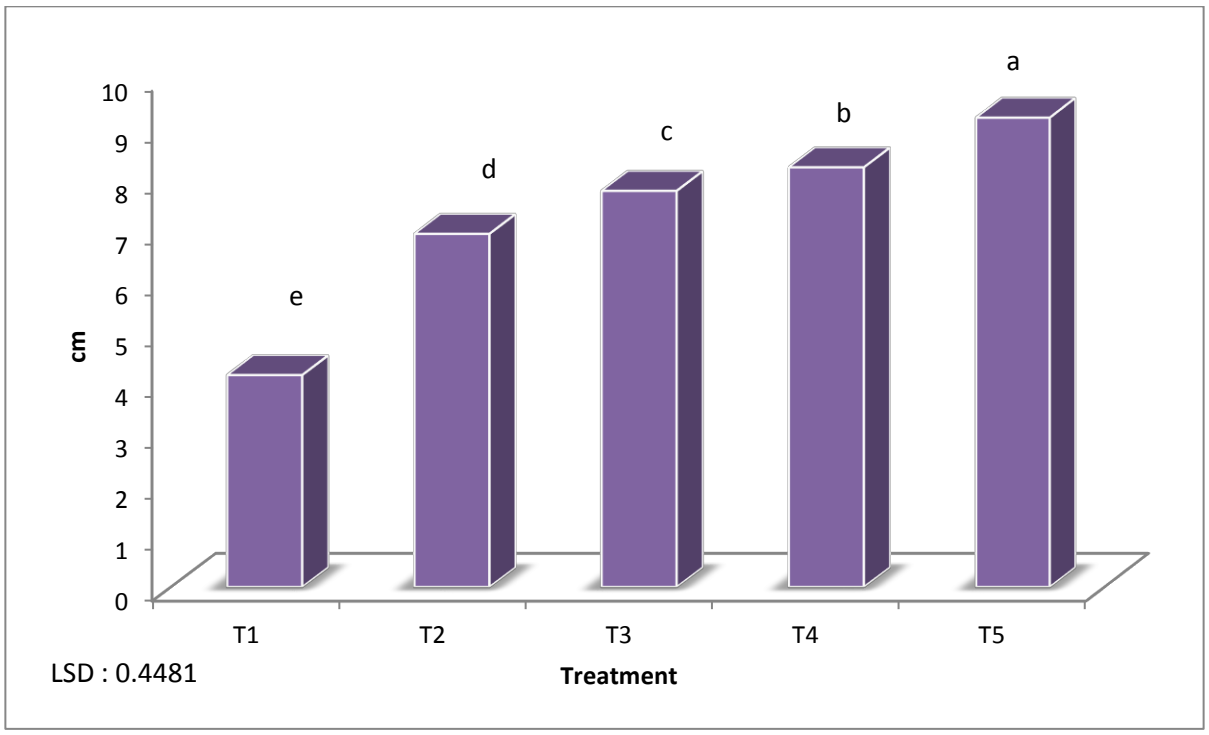
Means values followed by the same letter in the same column are not significantly different at $P<0.05$, based on least significant different test (LSD).
T1, 0 g/tree per year + No Mulching
T2, 480 g/tree per year + No Mulching
T3, 720 g/tree per year + No Mulching
T4, 480 g/tree per year + Mulching
T5, 720 g/tree per year + Mulching

Total Plant Girth

Figure 2 gives the total plant girth of RRIM 3001 planted on Batang Merbau series based on different treatments. There was significant difference between treatments in term of girth measurements. The highest value in term of girth measurement is T5 >

T4 > T3 > T2 > T1 (9.2 > 8.2 > 7.8 > 6.9 > 4.2) respectively. This result proved that mulching practices showed better performance compared to treatment without mulching practices.

Figure 2: The total mean plant girth due to different treatments after one year period of planting in Batang Merbau Series.

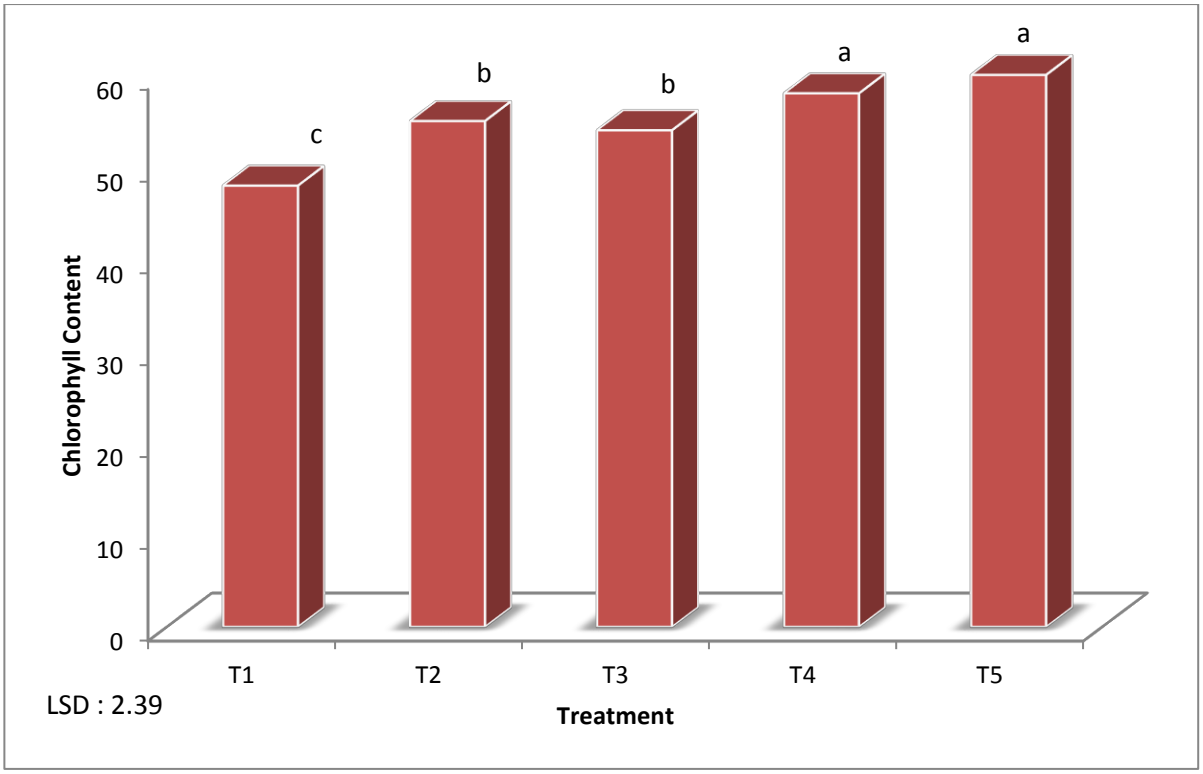


Means values followed by the same letter in the same column are not significantly different at P<0.05, based on least significant different test (LSD).
T1, 0 g/tree per year + No Mulching
T2, 480 g/tree per year + No Mulching
T3, 720 g/tree per year + No Mulching
T4, 480 g/tree per year + Mulching
T5, 720 g/tree per year + Mulching

Chlorophyll Content

Figure 3 shows that the chlorophyll content for Batang Merbau series based on different treatments after one year of planting. The result obtained showed there was significant difference between the treatments. The treatment T5 and T4 (60.1 = 58.1) indicate the highest value of chlorophyll content compared to T3 and T2 (54.5 = 59.5) and the lowest of chlorophyll content was found from T1 (47.8). The mulching practices give a higher value of chlorophyll content compared to the treatment without mulching practices.

Figure 3: Chlorophyll content for Batang Merbau Series



Means values followed by the same letter in the same column are not significantly different at P<0.05, based on least significant different test (LSD).
T1, 0 g/tree per year + No Mulching
T2, 480 g/tree per year + No Mulching
T3, 720 g/tree per year + No Mulching
T4, 480 g/tree per year + Mulching
T5, 720 g/tree per year + Mulching

DISCUSSION

When forests are cleared for agriculture, changes detrimental to the environment can occur largely due to alterations in the hydrological cycle, micro-climate, biological populations and soil physical properties. (Samarappulli et. al., 1999). Mulching increases and conserves moisture in the soil and also encourages more prolific root development. (Pushparajah & Yew, 1977). In agricultural practice, mulching now includes the application of any of a variety of materials to the surface of the soil around the stem of the growing plant, with a view to improving conditions for the root. Mulching can benefit soil conditions in a variety of ways. Mulch protects the soil from extremes of temperature; in temperate climates market garden crops are thus protected from frost in order to force early growth. An example of the practice to reduce soil erosion is mulching, extensively employed after the harvest in dry land farming. Mulching affords an important means of conserving water, not only by evaporation but also by improving the permeability of the soil surface to rain; it is used with tropical crops such as coffee and sugar cane to ameliorate drought. A layer of mulch will also suppress weeds. Mulching is most necessary during the first twelve months of growth; after this period the rubber roots should be exploiting large area of soil and so should be less sensitive to drought. The rate of girthing of young trees has been shown to be increased by mulching (Rubber Research Institute of Malaysia, 1956). Mulching, a form of low input technology, is a recommended practice in *Hevea* cultivation. Mulching not only protects the soil surface from erosion by rain, but also provides a cool and moist environment for root growth (RRIM, 1956). Samarappuli (1992) found that rice straw as mulching material for immature rubber improved the nutritional status of the soil. In early growth, the young *Hevea* plant depends greatly on the condition of the surface soil as its root system is confined mainly to that layer. With proper mulching which keeps the soil moist and cool under adverse weather conditions, root development is enhanced (Mahmud, 1995). Batang Merbau series is classified as fine loamy siliceous, isohyperthermic, family of Orthoxic Tropudult and developed from igneous and high grade metamorphic rocks. They have yellow colours (7.5 YR to 10 YR), fine clay (35-60%) and fine silt (<30%) (DOA., 2011). In this study, Batang Merbau series has yellow to yellowish brown (10 YR 6/4 – 7/8), consists of 38% clay, 4% silt and 58% sand. There are few types of soil series that are almost similar to Batang Merbau series such as Bungor series and Tembeling series. However, they are differentiated by parent material, which is Batang Merbau consists of quartz, while Bungor series consists of shale and Tembeling series consists of Tuffaceous shale (DOA, 2011).

In term of plant growth of RRIM 3001, the mulching practices showed better performance on Batang Merbau series, which is higher girth increment compared to the non-mulching practices. On the other hands, RRIM (1953) noted that mulching around the young plants during the first year after planting will assist growth by maintaining moisture content and a lower temperature in the surface soil. Girth of young trees increases during mulching (RRIM, 1956). In this study, Batang Merbau series had more than 50% of sand, followed by clay and silt in term of soil physical properties. Chan *et al.,* (1974) reported that non-uniformity

of growth is due to the soil textural variation and the patches of poor growth or performance are likely to be found on sandier soils. In addition, Sivanadyan (1972) reported that there can be excessive leaching losses due to lack of clay that retains moisture and nutrients. Mulching would be beneficial to ameliorate this situation. Furthermore, Haridas *et al.,* (1987) in his study on the nutrient content of various mulching materials reported that wild bananas were found to contain the highest level of nutrients, particularly nitrogen and potassium, followed by grasses and oil palm fronds. However, Gurmit *et al.,*(1989) emphasized in his study that empty fruit bunches (EPB) of oil palm are the most desirable mulching material as they are potential sources of both organic matter and nutrients.

CONCLUSION

The result obtained from this experiment proved the effect of fertilizer application and mulching practices give favourable effect on the growth of RRIM 3001 based on girth measurement and chlorophyll content analysis. For the response of rubber trees towards mulching practices, it can be concluded that the mulching practices has responded to girth and height measurements by comparing to the non-mulch practices. The response in physiological aspects showed that the mulching practices had higher values than other treatments which are non-mulch practices. Similar result was observed in chlorophyll content which is mulching practices which gives higher result compared to non-mulch practices.

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