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Yield Variation during the Period (April to July) 2017 in RRIC 121 & BPM 24 Rubber Clones (*Hevea brasiliensis*) Grown in WL_3 Agro Ecological Zone of Sri Lanka

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ABSTRACT

Monthly yield variation in rubber cultivations is common and it affects the livelihood of rubber smallholders and also the cash flows of plantation companies. The effect is more pronounced in rubber harvesters, workers, and other stakeholders as their income levels are partly governed by the monthly financial performance of the cultivation. This uncertain income levels results in the out migration of work force, causing the declining of rubber harvesters and other workers in WL_3, Agro Ecological zone. This has become a major problem faced by the entire plantation industry in Sri Lanka. Thus a thorough knowledge on the variability of yield is essential for accurate estimation of monthly yields and income levels and thereby planning marketing and related activities. Therefore, the main objective of this study was to establish variation pattern in the yield components of two *Hevea brasiliensis* clones grown in WL_3 agro ecological zone in the country and to find possible reasons for such variation. Further, ways of enhancing yield and income levels were also looked at using the Ellakanda and Katuhenadivisons of Sorana Estate managed by Kotagala Plantation PLC as the study site. Based on the previous literature, relevant theories were formulated; independent and dependent factors that would result in the monthly yield variation and the required information to be collected were identified. Primary data were collected using tapping blocks of the selected divisions along with relevant meteorological data.

The raw data were classified to purposeful and usable categories and were tabulated for statistical inferences. Results revealed that the physiological ability of the tree to produce latex, number of tapping days and the rainfall pattern as the main factors which affect the monthly yield variation of RRIC 121 & BPM 24 rubber clones cultivated in WL_3 Agro Ecological zone of the country.

Keywords-- Agro Ecological Zone, Livelihood, Rubber Clones, Yield Variation.

I. INTRODUCTION

Rubber (*Hevea brasiliensis*) introduced to Sri Lanka from Brazil via.UK in 1876 by Sir, Henry Wickham spreadrapidly in wet & intermediate zones and became one of the main plantation crops in the country. Currently in Sri Lanka 133,668 hectares of lands are covered with rubber plantations. 64% of the total rubber extent is under the smallholder sector. 35% is managed by Regional Plantation Companies (RPCs) with 1% coming under the Janatha Estate Development Board (JEDB) & Plantation Cooperation. (Rubber Development department – Statistics 2016).

Sri Lanka is categorized as one of the nine major producers of natural rubber in the world and rubber industry contributes to the economy of the country in terms of foreign exchange earning and as a source of employment. The rubber industry provides direct and indirect employment for over 500,000 whilst contributing to the livelihood of smallholders as well. Rubber plantations gives immense value to the environment by fixing atmospheric CO_2contributing to reduce global warming, soil conservation, enrichment of nutrients & improving soil structure. (EDB – Natural Rubber industry In Sri Lanka - 2016).

Generally, rubber yields drop below average during February to July each year, followed by 'Peak Yielding' period extending from November to end of January. Therefore, the above mentioned annual yield cycle can be considered as natural strata of yield levels (Wijesooriya et. al, 1997).

Amount of rainfall and its intensityis highly influencing the yields by no tapping, late tapping and washouts dates and about 30 – 35% of potential crop is lost during each year. This affects the income levels of and land owners, tappers and factory workers. Hence, various methods are adapted to minimize the crop loss caused by interference of rain fall on tapping. Conducting, recovery tapping, rotation tapping and use of

rain guards are some techniques used by the growers (A. Nugawela & Thilakaratna, 2001).

Within a year, there is a significant variation in monthly rubber production in WL_3 Agro ecological zone resulting in inconsistent income levels for stakeholders (Anon, 2017). Their income in some months of a year is inadequate for their day today expenditure, aggravating their socio-economic problems. Plantation companies and private estates are also affected and in some such months they stop or reduce their allocation of votes for sundry work and agronomic practices. Therefore a better understanding of 'monthly variation in yield components' (Latex) could facilitate to find solutions for income variation and development activities of plantations.

II. MATERIALS AND METHODS

The study was carried out at Ellakanda and Katuhena divisions of 'Sorana Estate' located at WL_3 Agro – ecological region and, managed by Kotagala Plantation PLC. Two tapping blocks were randomly selected from each of the fields (2005, RRIC 121, 17.48 hectares and 2007, BPM 24, 10.7 hectares). A tapping block consisted of 300 tapping trees and tapped 1/2S D/2 system on panel 'B0 – 1'. All tapping blocks have been tapped by skilled tappers since the commencement and have been managed under similar agricultural practices and management techniques implemented by the Kotagala Plantation PLC Data were collected for a period of four months from April to July in the year 2017. For each tapping blocks and on each tapping days latex volume (in Liters) and dry rubber content were measured using metrolac reading at the weighing point of the Estate as primary data.

Further, in each tapping block, tree girth was measured using 10% of randomly selected healthy trees (10% of the sample = 30 trees and totally 60 trees). Meteorological data, i.e. rain fall, relative humidity were collected from state meteorological station. By using tabulated raw data on latex volume and metrolac reading the monthly total weight of dry rubber yield was calculated and the monthly total tapping days of each block in two clones were recorded. There after monthly yield (Kg), (IPT) intake per tapper (Kg) and the yield grams per tree per tapping (G/T/T) of two clones were recorded. Yield variation pattern was determined by comparing significance levels of the relationship with GTT, meteorological data and tree girth measurements.

III. RESULTS AND DISCUSSION

Table 1: Average harvesting record of RRIC 121 clone, from April to July in year 2017

Month	Crop (Kg)	Yield(YPH)	Tapping days	IPT(Kg)	GTT(g)
April	102.8	92.5	14.0	7.3	24.3
May	072.8	65.5	09.0	8.0	26.7
June	047.5	42.7	07.0	6.8	22.7
July	187.4	168.7	20.5	9.1	30.3

Table 2: Average harvesting record of BPM 24 clone, from April to July in year 2017

Month	Crop (Kg)	Yield(YPH)	Tapping days	IPT(Kg)	GTT(g)
April	52.3	55.6	09	5.8	19.3
May	33.7	35.8	05	6.7	22.3
June	8.4	8.9	1.5	5.6	18.7
July	106.8	113.6	14	7.6	25.3

Even though two fields were located in close distance and under similar climatic conditions in the same estate, yield performance of the two clones were different and RRIC 121 had given better yield performance than BPM 24.

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Number of tapping days and yield variation of two clones during the study period:

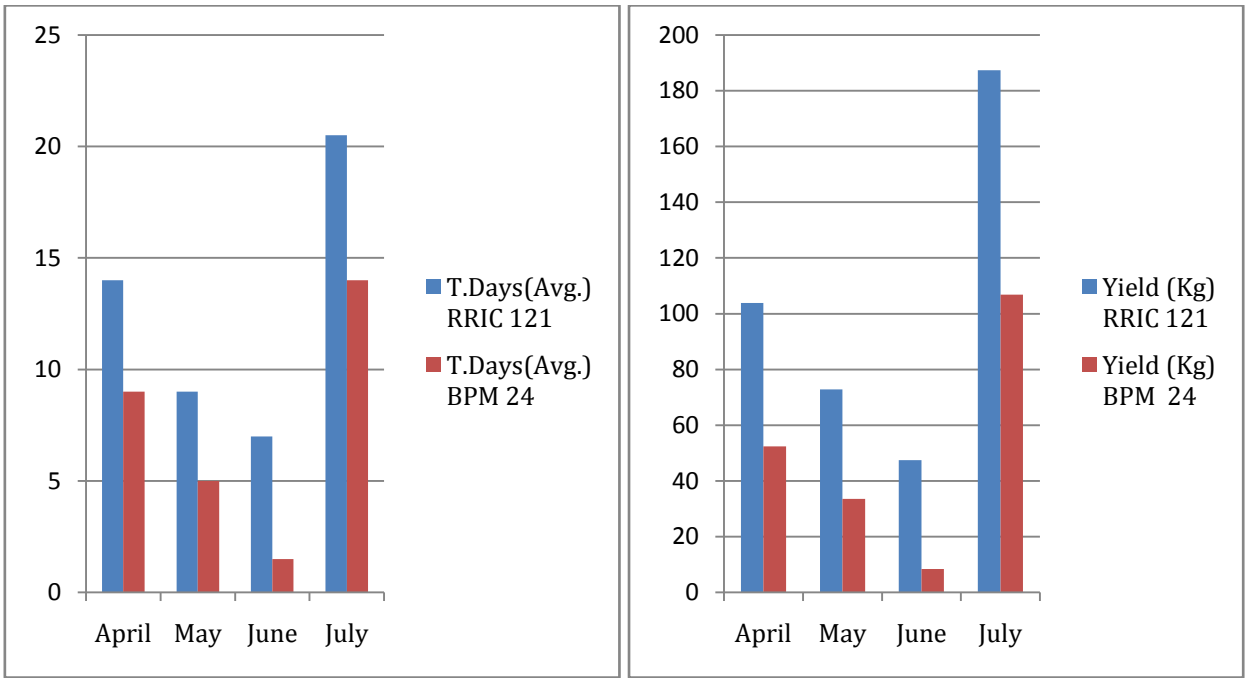

Figure 1: Number of tapping days and yield variation

As shown in fig. 01 highest number of tapping days for both clones had been recorded in the month of July and minimum in June. April recorded higher number of tapping days than May in of both clones. Monthly yield variation of both clones followed a similar pattern.

Statistical results revealed there was significant correlation between tapping days and the yield of both clones which was established by probability values (P = 0.012, P = 0.015) which were lesser than (P <0.05) as shown in Figs. 2 and 3.

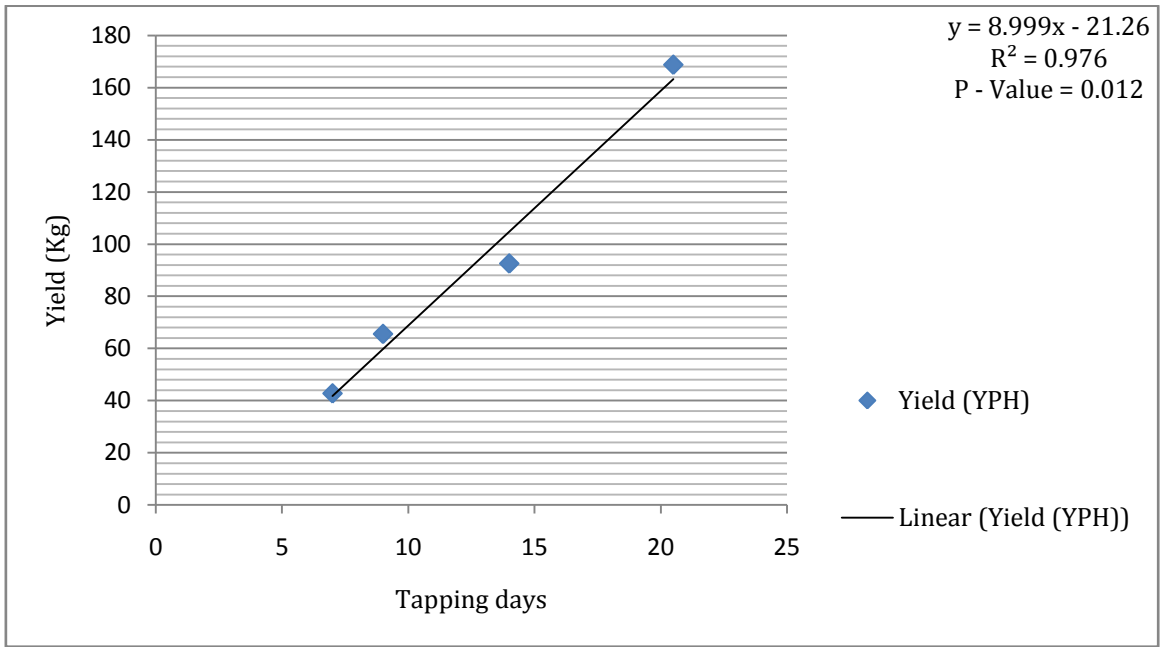

Figure 2: Correlation of Tapping days and the Yield of RRIC 121 Clone

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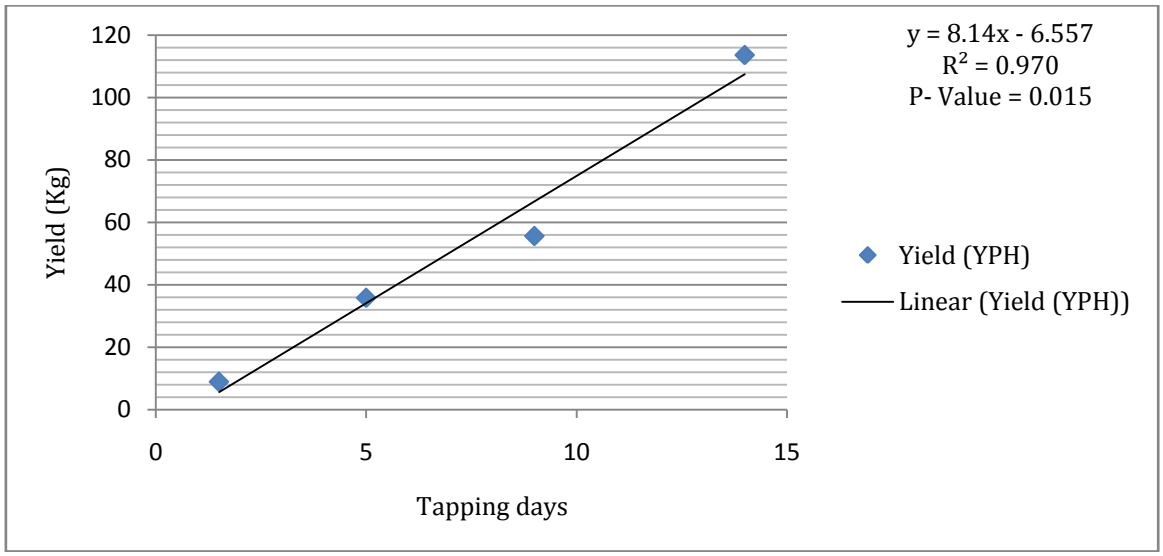

Figure 3: Correlation of Tapping days and the Yield of BPM 24 Clone

Thus it is very clear the yield of both clones gives highest value in July and performed way of other three months also significantly correlated with the tapping days of each month of each clones respectively. Furthermore, result revealed, that even though both clones of RRIC 121 & BPM 24 were planted in very close locations to each other, number of tapping days were significantly different between two clones in the entire experimental period as shown in table 1 and 2. When comparing the yield variation pattern during the study period, clone BPM 24 showed significantly lower yield with the less tapping days than that of RRIC 121clone with the similar rainfall pattern shown in Fig. 4 and Fig. 5.

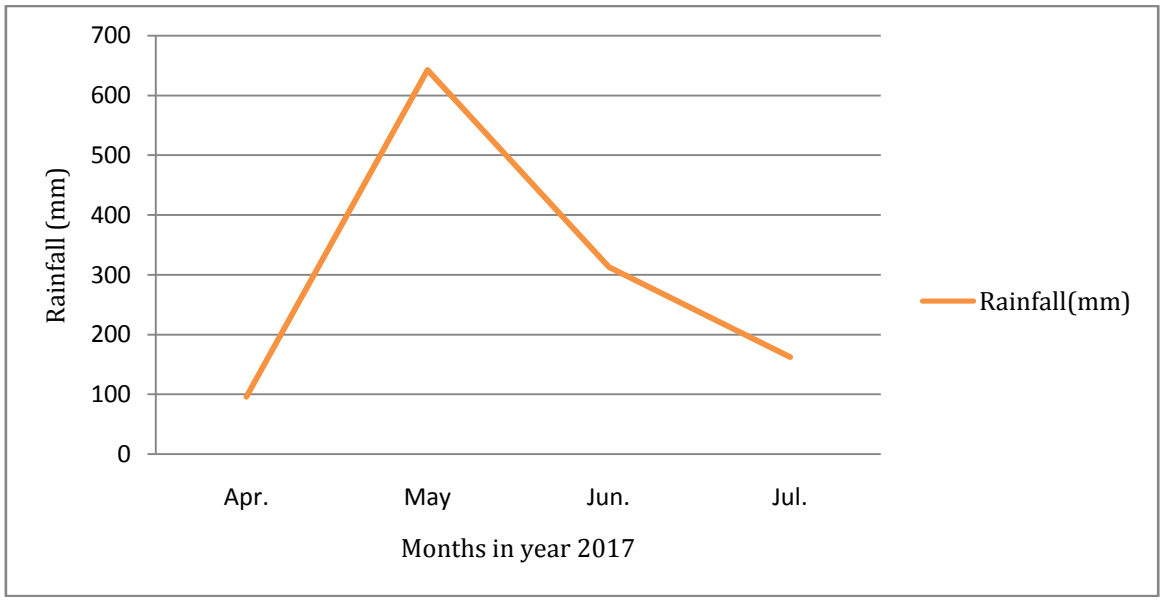

Figure 4: Rainfall (mm)

Monthly rainfall (mm) performed as highest in May and lowest in April in the experimental period as shown in fig. 4, and rainy days performed in different way of highest in June as shown in fig. 5. Thus reviewe dliterature revealed degree of rainfall and number of rainy days more affected to determination of normal, recovery and late tapping days of rubber. This is mainly due to severity of panel wetness which determines the time taken to panel drying and commencing to tapping.

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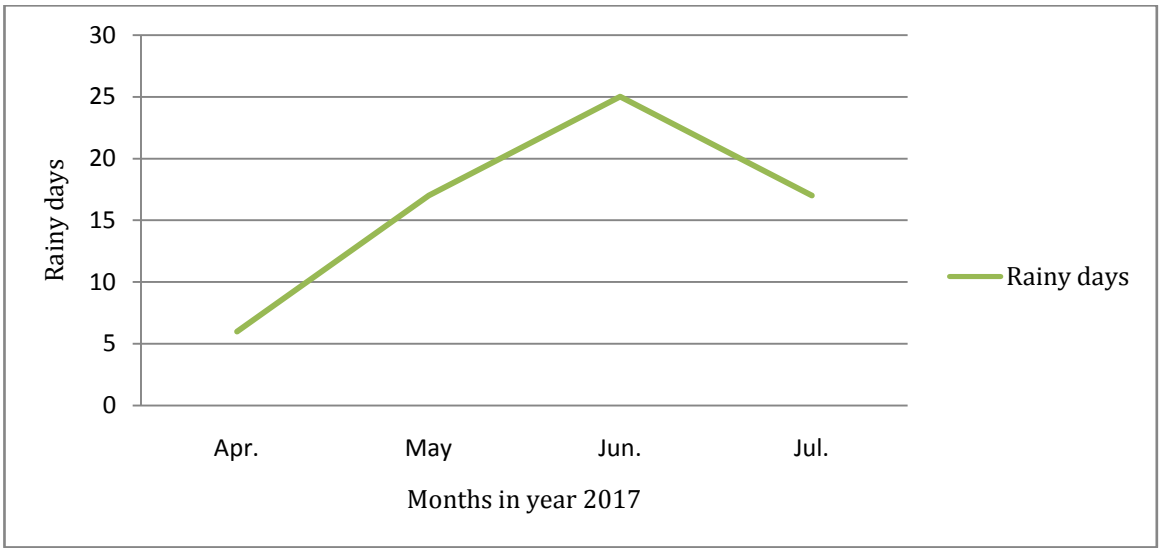

Figure 5: Monthly rainy days

Even though there were minimum rainy days in April, highest tapping days and yielder corded in July for both clones and highest rainy days in June, where recorded the minimum number of tapping days. It is very clear that rainfall was not only the factor affected to determination of tapping days in this four month experimental period of both clones. Although, reviewed literature established four seasonal quarters of the yield cycle of have were identical, the crop was below average from February to July. During this period rubber tree shed leaves which affect to reduction of photosynthesis and physiological ability of the plant. In March and April rubber plant bearing flowers and tender shoots, the next period post wintering start from May and extends up to July. There after crop increased up to above average because tender leaves were turn in to maturing stage during this period. The literature established, in physiologically high yielding months as August, September, and October as peak months of November to January. The identical yield cycle of rubber tree, was established by the obtained result of this research as shown in figure– 1,2.3,4 and 5, because yield in April showed in average level with minimum rainfall interfering as normal way of wintering month of low physiological ability (GTT).

After post wintering stage from May showed sharp increase in yield up to July. Except in July, May and June comparatively experienced lesser tapping days which leads abnormal yield due to higher rainfall of those two months affected to lesser tapping days as shown in fig. 4 and 5. This was further established by the performance of GTT and yield in both clones as shown in fig. 6.

Yield variation and GTT of two clones during the study period:

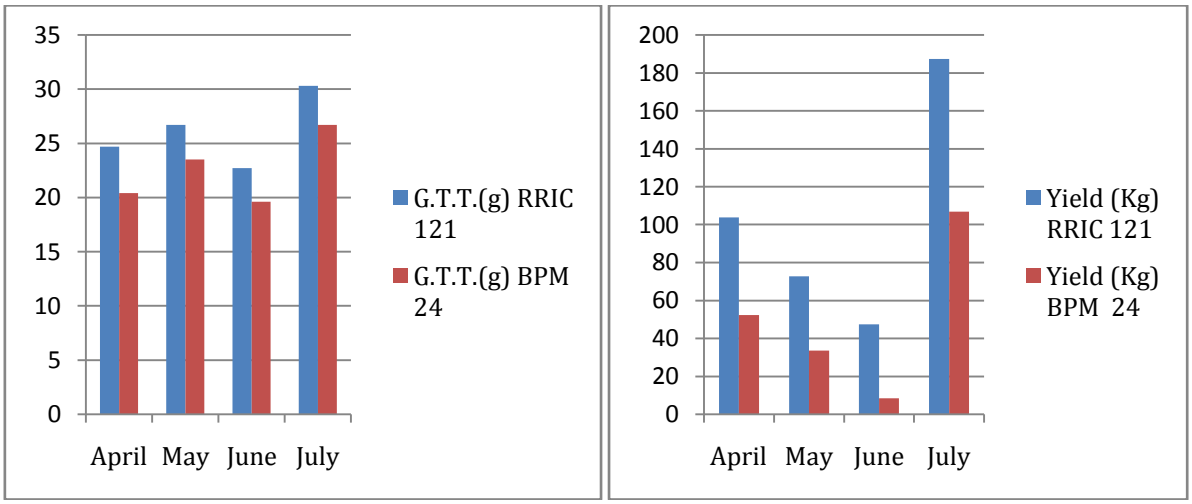

Figure 6: Yield variation and GTT

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Fig. 6, revealed there was sharp increased in GTT of both clones from April to July except June, simultaneously with the increment of physiological ability of Rubber. In month of June, previously higher exploitation with late tapping interfered to abnormal result of GTT. When considered the yield, it performed opposite way of GTT from April to June except July because higher number of rainy days as shown in fig. 5 affected to less tapping days which were interfered to abnormal yield of May and June by changing identical yield cycle to yield variation pattern of both clones in fig. 7.

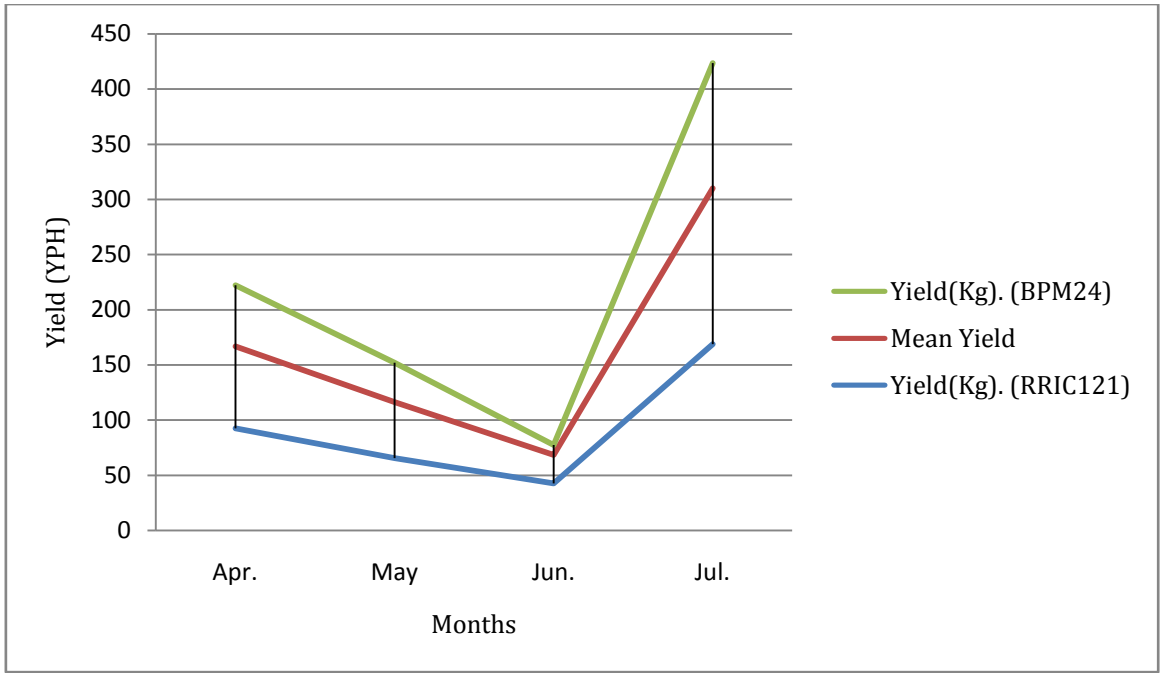

Figure 7: Yield variation pattern of two Clones and Mean Yield variation pattern

Probability value of two variances (P=0.313) which was higher than decimal zero and five (P>0.05). Therefore should accept the null hypothesis and means there was no significant variance between two yield variation patterns of both clones. When comparing the yield variation pattern during the study period, BPM showed significantly lower yield than that of RRIC 121. This is mainly due to the structure of the two plant species, where RRIC 121 is comparatively a taller plant. The number of tapping days was highly positive correlated with the number of rainy days. Due to the plant canopy structure, RRIC 121 had higher number of tapping days. Highest yield was recorded in month of July followed by April and the lowest yield was recorded in the month of June, where the highest rain fall was received. Intake per tapper (I.P.T.) and the Yield Gram per Tree per Tapping (G.T.T.) also showed the highest value in July and the lowest in June. The GTT & IPT Shown in Fig. 2, revealed sharp increase from April to July except the drop in June, which means there was an average increment of GTT and IPT from April to July in both clones.

Results further revealed that, there were similar numbers of potential tapping days in a same month for both clones. However, number of actual days tapped varied in each month. One reason for that is the extensive branching in BPM 24 close to the ground level compared to that of RRIC 121 and the lesser plant height of BPM 24 than that of RRIC 121 which caused to increase of the mutual shading that resulted bark wetness exist for long hours. Hence, it resulted in a lesser number of tapping days for BPM 24.Field observations showed that there were brown bast trees in both RRIC 121 and BPM 24 with 32 and 46 trees respectively in experimental sites. Higher number of brown bast trees also significantly affected to yield variation. Where none productive trees increased and affect to mutual shading with lesser number of tapping days due to bark wetness and difficult to tap. The crop figures of both clones in April were higher than those of May and similarly dropped in June with a sharp increased in July with a peak crop & yield as shown in Fig.-1, that numerical data disclosed there is yield drop in May and June comparatively interfered with lesser number of tapping days. As shown in Fig. 3, there was a significant increase (P<0.05) of yield in July compared to that of April. The number of tapping days in April was higher than those in May and dropped in June with the highest in July and further disclosed sharp declined in June and May correlated with tapping days which were manipulated by rainy days as shown in fig. 5.

As shown in fig. 6, that probability value (P= 0.313) which was established similarity of yield variation

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pattern of both clones. Thus mean yield variation pattern was established as yield variation pattern of RRIC 121 and BPM 24 Rubber clones of experimental fields in WL 3 agro ecological zone and that standard curve used to determination of significance levels of relationship with meteorological data of temperature, humidity and tree girth measurements as shown in Fig. 8,9 and 10.

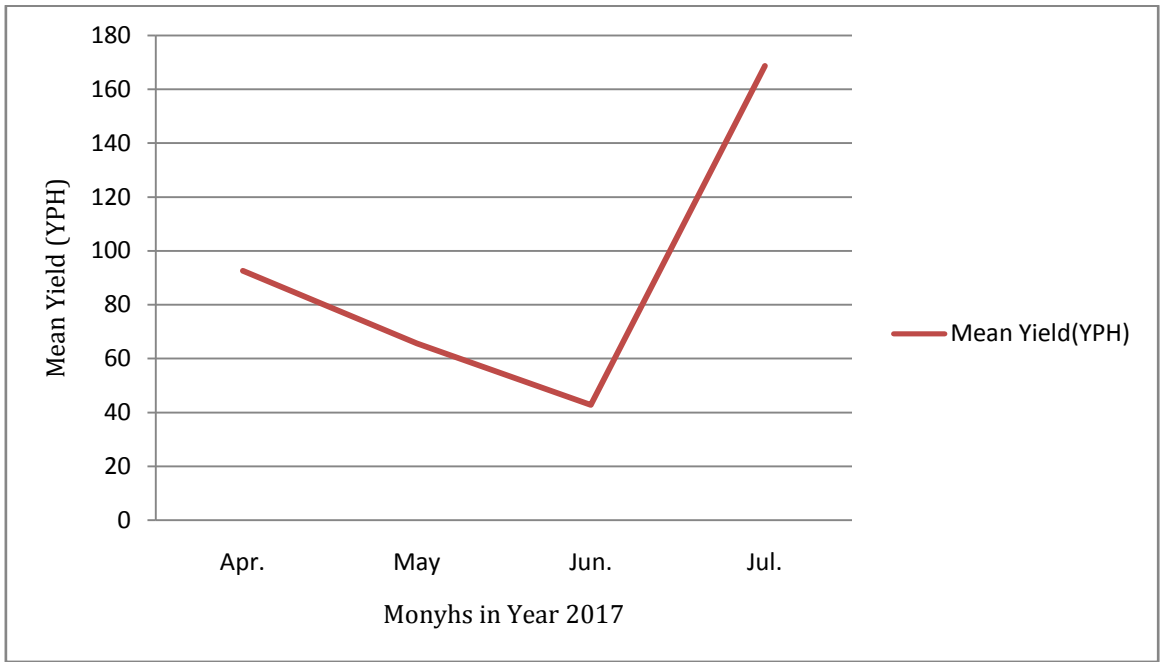

Figure 8: Yield variation pattern of both clones (Mean yield)

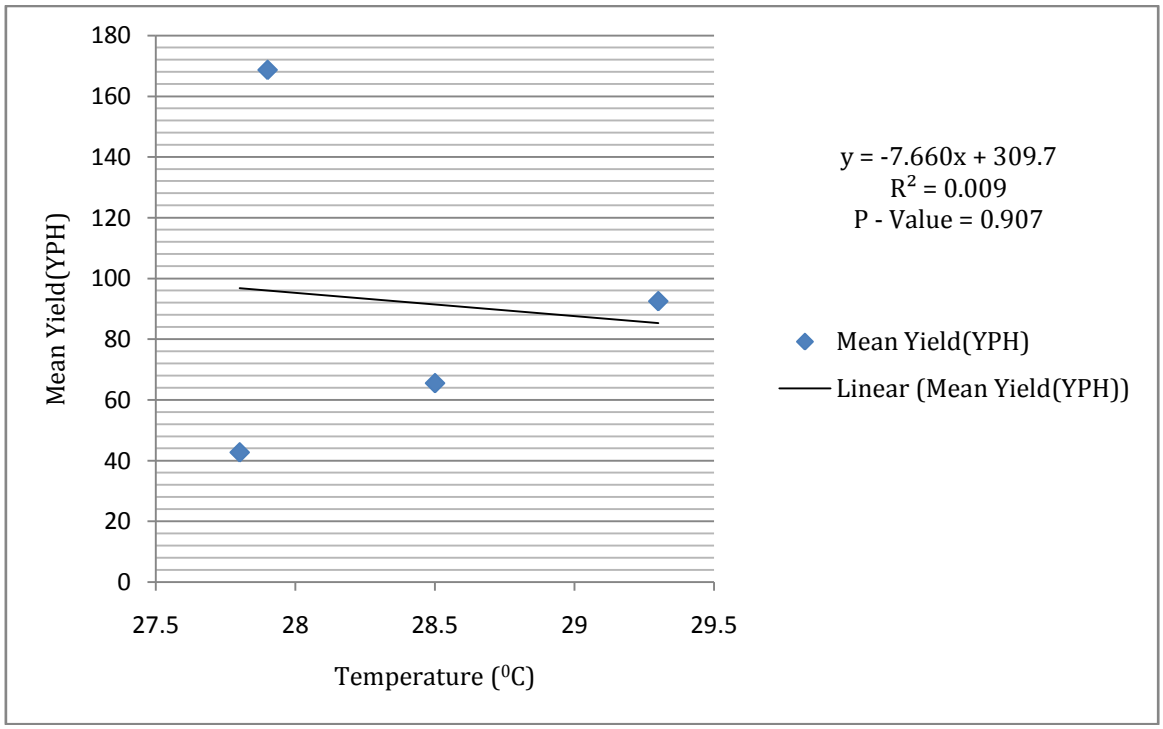

Figure 9: Correlation between temperature and the mean yield

As shown in figure 9, that probability value (P = 0.907) which was higher than (P>0.05)and it revealed there was not significant correlation between temperature and the yield of this experimental fields of both clones.

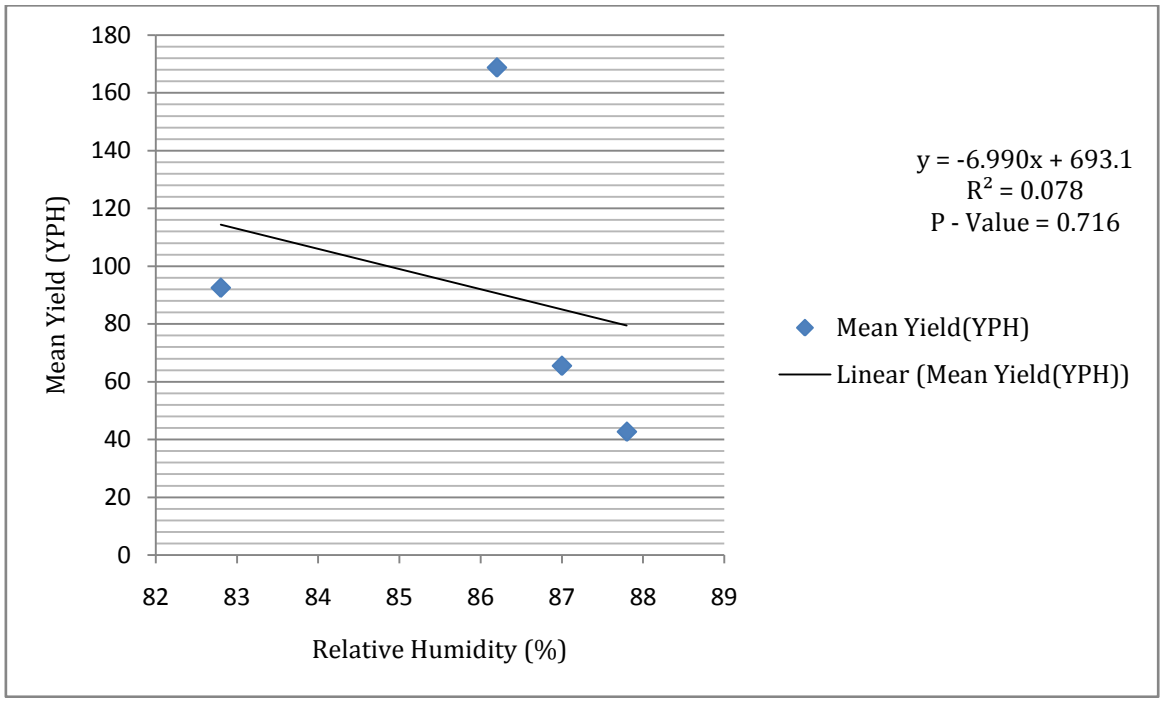

Figure 10: Correlation between relative humidity and mean yield

As shown in figure 10, that probability value (P = 0.716) which was higher than (P>0.05) and it revealed there was not significant correlation between relative humidity and the yield of this experimental fields of both clones as similar way of temperature. Means here there was not significant affects of temperature and relative humidity for the determination of yield variation pattern of RRIC 121 and BPM 24 rubber clones in WL 3 agro ecological zone in selected experimental fields.

Probability value of two variances of girth measurements in both clone (P=0.000) which was lower than decimal zero and five (P<0.05). There was a significant variance between tree girths of both clones. Even though there was significant variance with tree girths of two clones, there was not significantly difference between yield variation patterns of both clones and that similarity which was established by figure 6 and statistical inference of yield variance in both clones and it revealed there was not significant correlation between girth and the yield of these experimental fields.

IV. CONCLUSION

According to the results both clones RRIC 121 & BPM 24 showed similar yield variation pattern during the study period in WL3 Agro Ecological Zone.

The highest yield was recorded in the month of July and the lowest was recorded in June for both clones.

Yield variation pattern changed considerably due to the reduced number of tapping days as a result of the rainfall.

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