EFFECT OF AGE OF RUBBER PLANTATION ON TREE POPULATION, STEM GROWTH AND LATEX PRODUCTION

***Idoko, S.O., Uzu, F.O., Esekhade, T.U., Idehen, C. and Obazuaye, E.**

Rubber Research Institute of Nigeria, P.M.B. 1049, Benin City, Edo State, Nigeria
* Corresponding author's E-mail: onuidoko@yahoo.com

ABSTRACT

The effect of age of rubber plantation on tree population, stem characteristics and rubber latex productivity was studied to determine factors that may necessitate rubber plantation replacement. The study was carried out in the Rubber Research Institute of Nigeria's rubber plantations at Iyanomo, Benin City, Edo State, Nigeria. The experiment consisted of 1 hectare adopted in GT I plantations of 4, 18 and 45 years old plantations. Each of the plots was demarcated into three equal parts as replicates and arranged in a Randomized Complete Block Design to assess the effect of age on the physiological and latex yield of rubber. Data generated on the plant population, stem growth characteristics and latex yield of the rubber trees were subjected to analysis of variance statistics, and significant means were separated using the Least Significant Difference Test. The results showed that rubber population and yield of rubber decreased with age indicating that rubber tree can remain productive even beyond the age of forty years. Hence, reduction in plant population rather than age should determine the need for replanting of rubber plantation. .

Keywords: Age, Rubber plantation, Tree population, Stem growth, Latex.

J. Agric. Prod. & Tech.2013; 2(1):14-18

INTRODUCTION

Rubber (*Hevea brasiliensis* Muell. Arg.) production in Nigeria has been on the decline since 1970s. Enabor, (1986) and Michael, (2006) estimated the rate of decline to be close to 50% (248,900 – 154,000 ha). The reasons for the decline were attributed to poor plantation management, unstable market prices of rubber, over dependence on petroleum revenue and lack of access to farm credit which encouraged many local farmers to pay less attention to their plantations. The resulting effect of which was low latex yields either as a result of old age or non suitability of the land on which they were planted and eventually abandonment of the old plantations as revenue declined. However, the recent increases in the price of natural rubber due to its higher demand in the international market and the need for Nigeria to diversify her sources of revenue and create employment for the restive youth in the Niger Delta which coincide with the rubber belt of Nigeria, makes it imperative to increase rubber production in Nigeria and the convenient place to start is the restoration of the large hectares of old and abandoned rubber plantations in the country.

Objectives of the Study: The specific objectives of this research works therefore were to determine the effect of age on (i) rubber tree population, (ii) stem growth of rubber and (iii) the latex yield of rubber.

MATERIALS AND METHODS

Location: This study was carried out in Rubber Research Institute of Nigeria (RRIN) main Station at Iyanomo, near Benin City, Edo State, located between longitude 5°35' and 5°55'E and latitude 6°05' and 6°25'N. The land is part of the coastal plain sands of the Niger Delta

Basin. They were described as the coastal plain sands that are partly marine, estuarine and deltaic or fluviolacustine in origin (Kogbe, 1975). The climate of the area is humid tropical, characterized by deep, porous sandy to loamy sand surface soils overlying sandy loam to sandy clay sub soil. Soil reaction is usually strongly acid to very strongly acid. The 45-year old plantation was opened up from natural forest in 1960 with no history of fertilizer application for about 20 years before the commencement of the study. While the middle aged (18 years old) plantation and the young (4 years old) plantation were opened up for cropping more than 30 years ago with several cycles of arable cropping under a bush fallow system, alternating 3 years of cropping and 5 – 7 years of bush fallow system. The early age rubber plantation was first planted in 1999 but the plantation suffered wild fire devastation in the year 2000 and was replanted in 2002.

Data collection: One hectare area each was adopted in each of the three age categories (young, medium and old) planted to GT I rubber clone, for the purpose of the study of the impact of age on the productivity of rubber. Each of the adopted plots were divided into three equal parts as replicates. The census of the trees including the number of productive trees in each replicates were recorded, stem girth and length of tapping cut were recorded from a sample of 10 randomly selected healthy trees. Rubber latex yield were collected using the half spiral, alternate days tapping systems without stimulation. The rubber latex yield in mature trees was estimated according to Nair (2000) procedure which states that:

$$Y = \frac{F \times L \times Cr}{P}$$

Where:

Y = Actual Dry Rubber Content (DRC) yield obtained from tapping

F = Mean initial flow rate per cm of tapping cut in the first 5 minute after tapping

L = Length of tapping cut

P = Plugging index i.e. a measure of the extent of latex vessel plugging

Cr = Rubber content of the latex (Percentage DRC by weight).

$$\text{Initial Flow rate (IFR)} = \frac{\text{Volume in 5minutes}}{\text{5 minutes}}$$

$$\text{Plugging Index} = \frac{IFR}{V_2} \times 100$$

Data Analysis: All the data sets were subjected to the F-ratio test using the GENSTAT (2008) procedure. Means were separated using the Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Effect of Age of Rubber Plantation on Rubber Tree Population: The result of the effects of age on the census of rubber tree population (Table 1) showed a significant ($p \leq 0.05$) reduction in plant population of rubber at old age (40 years). The number of rubber tree survival in the old aged rubber plantation reduced from 420 plants per hectare at planting to 237, 222 and 171 in the young, middle and old aged rubber plantations respectively suggesting 56, 53 and 41% reduction. The old rubber plantation lost significantly ($p < 0.05$) more rubber trees (243 stands, representing 58% reduction) compared with the young (46% reduction) and middle aged trees (47% reduction). There was also a 25% significant ($p < 0.05$) reduction in the number of productive rubber trees in the old rubber plantation compared with the young (227 stands representing 54% of trees planted) and middle aged (38% of trees planted) rubber plantations respectively. It must be noted that the number of tappable trees in the young plantation may rise, as the trees that were not fully matured were considered as among the untappable trees. The reduction can be attributed to poor plantation management that leads to disease infestation such as white root rot and cholectotricum, and invasion by parasitic plants like mistletoe among others, poor tapping techniques and wind damages.

Effect of Age of Rubber Plantation on Rubber Stem: The result of effects of age of rubber plantation on rubber tree stem characteristics (Figure 1) showed a significant ($P \leq 0.05$) increase in the stem girth and length of tapping cut with age of rubber. The stem girth of rubber trees increased from a mean of 23.1 cm in the young rubber plantation to 85.4 cm and 136.3 cm in medium and old rubber trees respectively. The length of tapping cut increased from a mean of 32.3 cm in the young rubber plantation to 43.4 cm and 62.3 cm in the medium and old plantations respectively. This is because stem girth determines the length of tapping cut and it is largely a biological phenomena and a function of age of rubber plantation. The order of the stem girth and tapping length were in the order old > middle age > young aged rubber plantations respectively. This is due to the fact that any high yielding rubber tree must have capacity for a high rate of girthing so as to produce a large trunk and thus ensuring high potential yield. This is in line with the submission of Templeton, (1969) who reported that bigger stem girth and faster growth rate are important physiological characteristics of rubber tree with higher productivity.

Effect of Age of Rubber on the Productivity of Rubber: The latex yields of the three plantations were collected to determine the effect of age of the plantation on the productivity of the plantation. The DRC yield of rubber tree increased from 653 kg/ha/year in the young (1 – 6 years old) rubber plantation to 812 kg/ha/year in the middle age (15 – 20 years old) rubber plantation and 1042 kg/ha/year in the old aged (35 – 45 years) rubber plantation. This result indicates that rubber latex formation depend on higher growth rates as reported by Chua (1967). Despite the reduction in the tree population with age of rubber, there was a significant increase in the productivity of rubber plantation with age. This is because it is the number and the maturity of latex vessels as determined by bigger stem girth and longer length of tapping cut that largely determines the latex output of rubber rather than the age of the plantation. This means that, the economic life of rubber plantation can be extended beyond the age of forty years provided the factors that lead to loss of rubber stands are kept under control. This result conforms to the submission of George and Kuruvilla (2000) who estimated the economic life of rubber to go beyond the age of thirty years provided factors such as; price of rubber products, availability of high yielding clones, and plantation management practices are favourable. Suyanto *et al.,* (2001) also reported age, land tenure institutions and the efficiency of farm management of rubber trees as major factors affecting profit, which they concluded peaked at 32 and 34 years. This is contrary to the findings of Mesike *et al.,* 2009 that rubber plantations become unprofitable after the age of twenty five. As previously noted, rubber plantations in Nigeria have been on the decline largely due to poor plantation management, lackof access to farm credit as reported by Enabor

(1986) and reluctance of the farmers in adopting improved technologies such as planting of high yielding rubber clones, intercropping systems and other technologies developed by scientists (Aigbekaen *et al.,* 2000). Other factors identified as contributing to the decline in rubber plantations in Nigeria are planting with unselected planting materials due to scarcity and inaccessibility to improved planting materials with the consequences of low yield, undesirable secondary characteristics such as poor bark regeneration and poor girth increase rates. Bush burning, inadequate credit facilities, high cost of credit and exorbitant cost of vital production inputs also affect rubber farmers (Giroh *et al.,* 2008; Giroh and Adebayo, 2007).

Table 1: Effects of age on the census of rubber trees in the plantation

Age of Plantation	No. of missing trees	Percentage of missing trees	No. of surviving trees	Percentage of surviving trees	No of productive tree	Percentage of productive trees
Young	193	46	237	56	227	54
Middle age	198	47	222	53	158	38
Old	243*	58	171*	41	103*	25
Mean	**211**	**50**	**210**	**50**	**163**	**39**
LSD	**35**	**-**	**37**	**-**	**36**	**-**

* ($P \leq 0.05$)

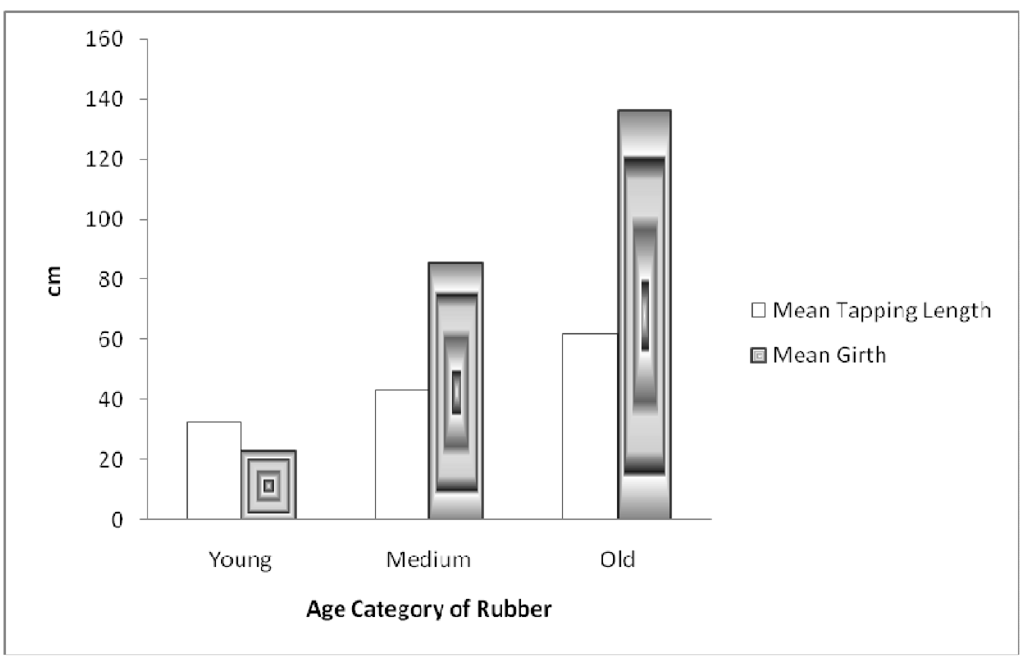

Figure 1: The effect of age of rubber plantation on the stem characteristics of rubber

Table 2: Effects of age on the latex yield of rubber trees in the plantations

Age of Plantation	Kg/tree/tapping	Kg/tree/hectare	Kg/hectare/year
Young	0.019	4.3	686
Middle age	0.032	5.0	812
Old	0.063*	6.5*	1042*
Mean	**0.036**	**5.2**	**831**
LSD	**0.01**	**1.2**	**200**

* (P ≤ 0.05)

CONCLUSION

- The economic life of a rubber plantation can be extended even beyond the age of forty years provided factors that lead to loss of rubber tree stands in the plantation such as diseases, poor tapping techniques, improper agronomic practices are properly controlled.

REFERENCES

Aigbekhaen, E.O., Imarhiagbe, E.O. and.Omokhafe, K.O. 2000. Adoption of some recommended agronomic practices of natural rubber (H*evea brasiliensis* Muell. Arg.) in Nigeria. *Journal of Agriculture, Forestry and Fisheries* 1**:** 51 – 56.

Chua, S.E. 1967. Physiological changes in *Hevea* trees under intensive tapping. *Journal of RRIM* 20 (2): 100 – 105.

Enabor, E.T. 1986. *Industrial Untilization of Natural Rubber Seed, Latex and Wood*. RRIN Seminar, Benin City, pp.1 – 7.

GENSTAT. 2008. GenStat for Windows, 7th Edition. www.vsni.co.uk/genestat

George, P. and C. Kuruvilla Jacobs. 2000. *Natural Rubber: Agro management and crop processing.* Rubber Research Institute of India, Kottayam, India pp 234.

Giroh, D.Y and Adebayo, E.F. 2007. Analysis of the technical efficiency of rubber tapping in Nigeria. *Journal of Agriculture and Social Sciences* 3(4): 140 – 142

Giroh, D.Y., Awah, A..A., Balogun, F.E., Igbinosa, F.O. and Wuranti, V. 2008. An Overview of Presidential Initiative on Rubber in the Presidential Initiative of Agricultural Reform in Nigeria. *Proceedings of the 13th Annual Conference, Agricultural Extension Society of Nigeria*. pp67- 75

Kogbe, C.A. 1975. Palaeogeographic history of Nigeria from Albian times. In: Geology of Nigeria (C.A. Kogbe Eds.) Elizabethan Publishing Company, Lagos pp 237 – 252.

Mesike, C. S., Sagay, G.A., Owie, O.E.D., Ehika, S.N., Ebenuwa, C and Ubani, S.E. 2009. Economic Replacement Model for Rubber Plantation in Nigeria. *Presented at the RRIN Semiar Series on the 24th June at Iyanomo*, Benin City, Nigeria.

Michael, U. 2006. Keynote address on the Presidential Initiative on Rubber Production and utilization. Rubber Research Institute of Nigeria, 17th January 2006.

Nair, N.U. 2000. Biotechnology and physiology of latex production. In: *Natural Rubber: Agro management and crop processing*. RRII 14**:** 249 – 261.

Suyanto, S., Tomich, T.P and Otsuka, K. 2001. Land demand and Land Management Efficiency: The Case of Smallholder Rubber Production in Customary Areas of Sumatra. *Journal of Agro forestry Systems* 50 (2): 145 – 160

Templeton, J.K. 1969. Partition of assimilates. *Journal of RRIM* 21 (3): 259 – 263.