VARIATIONS IN THE FIBRE LENGTH OF RUBBER WOOD (*Hevea brasiliensis* (Kunth) Muel Arg) GROWN IN SOUTH EASTERN NIGERIA

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ABSTRACT
Variations in the fibre length of rubber wood were investigated to determine suitability of the wood fibres for some industrial utilization. The fibre lengths were sampled according to main effects such as plantations effects, bud classes effects, trees effects, discs effects, cardinal directions effects and ring-blocks (radii) effects to determine variations in composition, based on the fixed effects model of a nested design. Macerated wood samples obtained at parallel positions to the grain were magnified on a visopan microscope and investigated in order of the sampled main effects. The plantations and bud classes effects were not significant ($p>0.05$), while the trees effects was highly significant ($p<0.01$). The effects of disc (position along the bole) and ring blocks (radii) were not significant ($p> 0.05$) on the fibre length composition. The cardinal directions effects was highly significant ($p<0.01$). The effects of factor interactions on fibre lengths were also investigated but not of practical importance. The mean fibre length value of sample trees was 1.59mm making it suitable for pulp and paper production.

INTRODUCTION

The rubber tree (*Hevea brasiliensis*) is a native of the upper Amazon Basin of Latin America. It is cultivated in tropical and sub tropical parts of the world for the production of its highly valuable white exudates (rubber latex), that constitutes the base for natural rubber production (Grilli et al, 1980, Ramli et al,1999, ICNR,2003, and IRRDB, 2003).

Enabor and Akachuku (1986) reported that commercial exploitation of rubber trees is maintained up to a period of 25-30 years beyond which the latex yield progressively declines and such over mature plantations cleared and the land prepared for replanting. However preliminary investigations of the morphology, anatomy, demand and availability of the wood of rubber in Nigeria, according to the report, indicated that it is suitable for a whole range of industrial wood products including pulp and paper, poles and sawn- wood. This study is therefore an indepth investigation of the fibre lengths of Nigerian grown rubber in south eastern state of Abia, so as to relate the wood quality with a range of industrial usefulness of the species and the possibility of controlling the wood fibre features silviculturally and genetically.

MATERIALS AND METHODS

Study Area

Abia Rubber plantations at Amaeke-Abam were sampled for the study. The plantations which are intensively managed for production of latex are located in Arochukwu Local Government Area of Abia State in South Eastern Nigeria. It occupies about 300 hectares and lies toward the northern limit of the lowland rain forest zone of Nigeria. The topography is undulating with slopes and elevations.

SAMPLING PROCEDURE

1. Two rubber plantations in the study area were sampled to accomplish the objectives of the study. The first plantation referred to as plantation 1 was 42 years old. The second

plantation referred to as plantation 2 was 37 years old.

2. Each plantation was established with both unbudded and budded seedling stock. The two bud classes (unbudded and budded) formed the next stage of sampling within each plantation.
3. In each bud class, 4 trees were sampled making a total of 16 trees sampled in the two plantations; sampling was selective for trees with good form, located away from the boundaries of each plantation to avoid boundary effect. Each sampled tree was first marked in four cardinal directions of North, South, East and West.
4. Disc sampling (Axial direction). Four discs of 5cm thickness were collected from each sampled tree. A total of 64 discs were obtained from 16 sampled trees.
5. Sampling in Radial direction (Age): In the radial direction of each sampled tree, 16 discs which are the first discs at the base of each tree were used for the study because they represent the oldest part of the trees. Ring Block of 5 rings each from all the samples were collected in the four cardinal directions from pith to bark of all 16 sampled trees. A total of 480 ring blocks were used for this purpose.

Measurement of Fibre lengths

The fibre lengths were measured with the aid of a Reichert Visopan microscope in the pulp and paper laboratory of the Federal Institute of Industrial Research Oshodi, Lagos. Wood slivers parallel to the grain, obtained from different positions of the ring blocks were macerated in equal volumes of hydrogen peroxide and glacial acetic acid, heated at temperature of 150 ^{0}C for 1 hour. The macerated fibres after being washed free from liquor were agitated in test tubes to free the individual fibres, and stained on microscopic slides. Staining was achieved using concentrated hydrochloric acid for dehydration and fluroglucinol as the staining agent. The prepared slides were mounted one after the other on the visopan microscope, which projected all fibres on a translucent screen. The fibre lengths of 30 randomly selected fibres were measured from each slide for statistical analysis.

Statistical Analysis of Data

Based on the sampling procedure, the fixed effects model of a nested design was used in the analysis of variance, to assess the effects of the main factors: plantations, bud classes, within trees (axial and radial) between trees and cardinal directions and their interaction effects on fibre length.

RESULT AND DISCUSSIONS

Plantations effect

The result of the analysis of variance shows that the fibre length in the 42 years old and the 37 year old plantations did not differ significantly ($p>0.05$). The mean fibre length were 1.57mm and 1.62mm in the 42 and 37 year old plantations respectively. This result indicates uniformity in fibre length produced in the two plantations, which may be linked to the fact that plantations at mature stages of growth usually produce wood features of uniform values, until senescence stage is reached when the value begins to drop. This trend has been reported by Miller (1976) on Juglans, **Akachuku (1982**) on *Gmelina arborea*, and **Cutter and Garrete (1993)** on eastern black walnut. Therefore, wood from any of the plantations is suitable for any wood based industrial/ research purpose requiring this range of fibre lengths (Fig. 1.0).

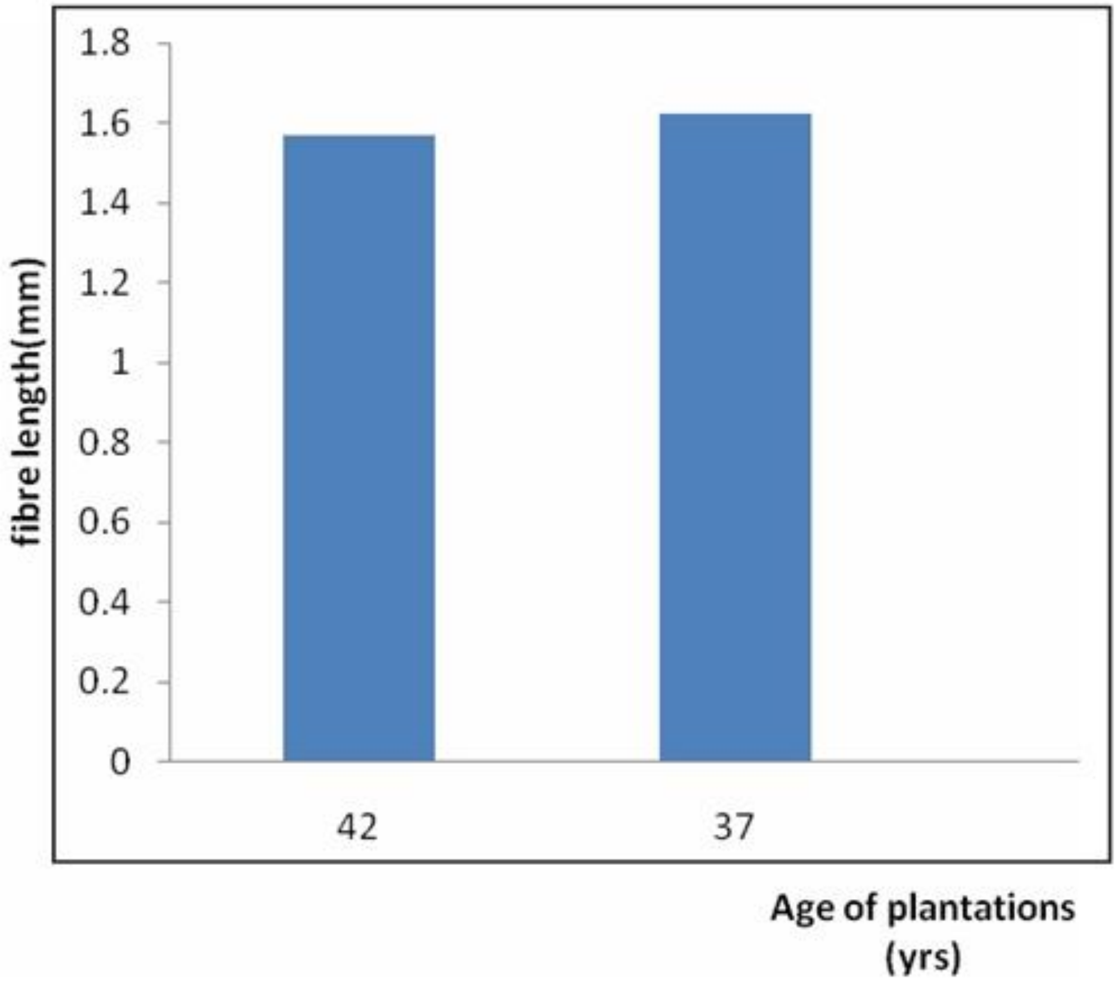

Figure 1.0: The effect of Plantations on fibre length of rubber wood

Bud Classes effect:

Analysis of variance results show no significant differences (p>0.05) in fibre lengths between the bud classes (unbudded and budded), the mean values of fibre lengths for unbudded trees were 1.55mm and 1.63mm for the budded trees. This implies that the budded trees only produced enhanced characteristics such as higher latex yield, resistance to drought and diseases, etc without changing the physiology of wood formation. Since wood in both the unbudded and budded trees was formed under similar physiological and environmental conditions their fibre lengths are expected to be uniform. Therefore, newer rubber plantation should be established with budded seedlings due to the advantage of obtaining higher latex yield and good quality wood of uniform fibre lengths for enhanced return on investment (Fig. 2.0).

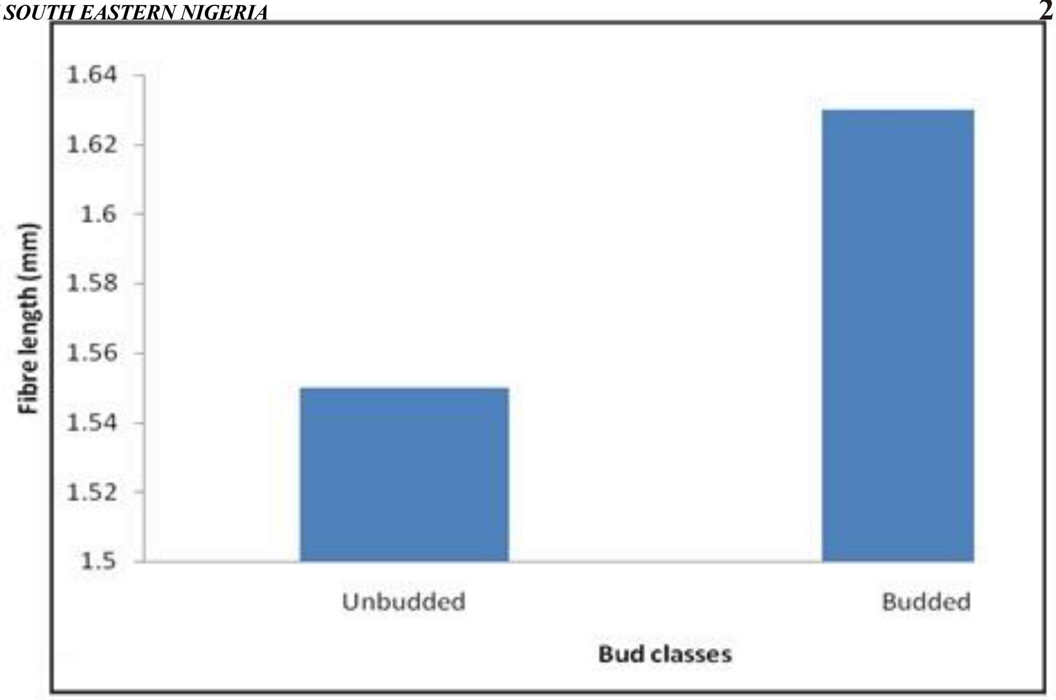

Fig 2.0: The effect of bud classes on fibre lengths of rubber wood

Between trees effect:

The results of analysis of variance from the different tree samples show highly significant differences ($p<0.01$) in fibre lengths between sample trees. The weighted mean values of fibre lengths between trees are 1.57mm, 1.56mm, 1.59mm and 1.64mm. This between-tree differences in fibre length may be partly due to the genetic makeup of the individual trees since the macro-effects of the growth conditions were not considered. This implies the possibility of improving fibre length by selection and breeding of trees with superior growth rate and fibre lengths (Fig.3.0). This significance between- tree differences in fibre lengths observed agrees with the result of Wilcox and Farmer (1968) on eastern cottonwood, Taylor (1974) on *Eucalyptus grandis*, Meaglin (1976) on northern red oak and Akachuku (1982) on *Gmelina arborea.*

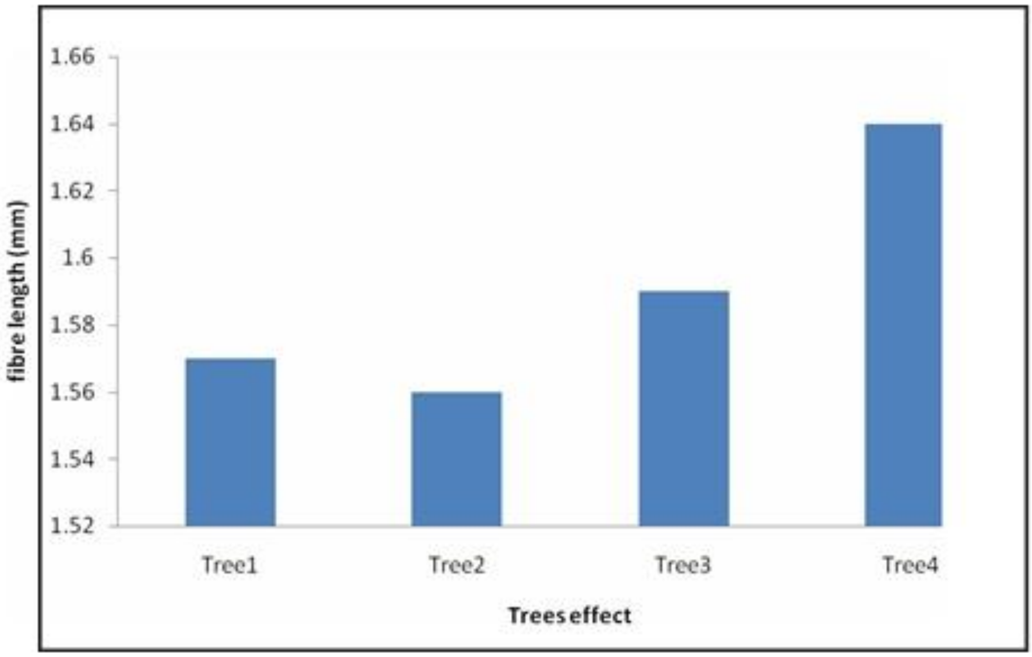

Fig 3.0: The trees effect on fibre lengths of rubber wood

Axial direction (positions along the bole) effect:

Analysis of variance results show no significant differences ($p>0.05$) in fibre length in the axial direction (position along the bole), indicating uniformity in fibre length along the boles of trees. This uniformity in axial fibre length may be related to the effect of early pruning, which promotes intensive competition from growth for hormones and photosynthates for apical growth. The remaining products were distributed along the bole and used for production of latewood. The early pruning continued until canopy closed, where the trees continued with more of apical growth and latewood production.

Radial Directions (Age) effect:

The analysis of variance results show no significant differences ($p>0.05$) in fibre length in the radial direction. This indicates similarity in fibre lengths produced in sampled trees from pith to bark, which may be related to the effect of early pruning, producing late wood growth sheaths of uniform features that appear as growth rings in the radial directions. Therefore, the uniformity in fibre length observed in the axial direction would also occur in the radial direction, since the wood in both axes was formed under similar physiological conditions of growth.

Cardinal directions effect

Analysis of variance results show that cardinal directions had highly significant effect ($p<0.01$) on fibre length. The results show that the fibre length in the Northern direction was 1. 58mm, 1.60mm in the Southern direction, 1.61mm in Eastern direction and 1.57mm in the Western direction (Fig 4.0). Highly significant differences in fibre lengths among cardinal directions may be attributed to local burging/eccentricity of leaning stems of rubber trees which were sampled which is often associated with reaction wood. Reaction wood produces wood characteristics of appreciable differences in the long and short radii, which agrees with Chow (1971) on fibre length of long and short radii in the bole of an eccentric sweet gum tree.

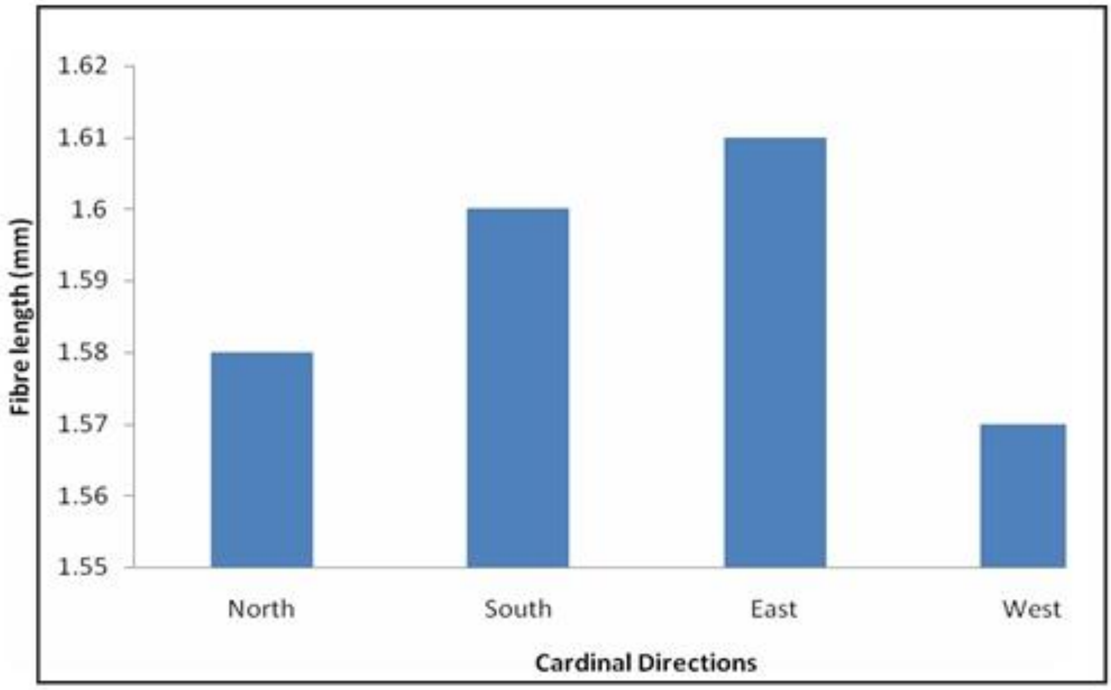

Fig 4.0: The effect of Cardinal directions on fibre lengths of rubber wood

Conclusions and Recommendations

1. The result of the study shows the mean value for fibre length to be 1.59mm which makes the wood suitable for pulp and paper production when mixed with long fibres from coniferous wood. However research should be undertaken towards obtaining cost effective methods of extracting exudates from rubber wood which may otherwise make the pulp and paper produced from this wood source relatively expensive due to the amount of cooking liquor required for maceration of the wood fibres.
2. The heritability of important anatomical features of rubber wood should be investigated conclusively by progeny test to enhance the possibility of tree improvement by using appropriate breeding programmes.

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