Genetic variation among nigerian Hevea provenances

Part I

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Abstract

Genetic variability in nursery growth parameters were examined in material from nine *Hevea* sources in Nigeria. Seedling height and diameter were measured for twelve months starting at the 3rd month after planting. Leaf area and top dry weight were determined at the 14th month after planting. The seedling performance of the Nigerian source material and the control (RRIM 600) was similar for the four characters studied.

Positive correlations were obtained between height, diameter, leaf area and top dry weight.

Very early selection in the nursery may not be possible for seedlings obtained from native and unimproved materials.

Key words: Provenance, source material, cultivar, growth vigour.

Zusammenfassung

Mit Hilfe von 9 *Hevea*-Herkünften wurde die genetische Variabilität von Parametern in einer Baumschule in Nigeria untersucht. Vom dritten Monat nach der Pflanzung an wurden Sämlingshöhe und Durchmesser über 12 Monate hinweg aufgenommen. Blattfläche und Sproßtrockengewicht wurden 14 Monate nach dem Auspflanzen bestimmt. Die Leistung der aus Nigeria stammenden Sämlinge stimmte mit der der Kontrollpflanzen (RRIM 600) in den 4 untersuchten Merkmalen überein. Positive Korrelationen wurden zwischen Höhe, Durchmesser, Blattfläche und Sproßtrockengewicht festgestellt.

Eine sehr frühe Selektion im Baumschulalter dürfte für nicht kultiviertes Material lokalen Ursprungs nicht möglich sein.

Introduction

Hevea seeds, probably from the original Wickham collections were introduced into Nigeria in 1895 (Tappan 1969). Smallholder plantations were established with plants raised from the seeds from these introduction. Tree density and husbandry practices among the small-holders were most irregular and yields obtained from the small holdings were estimated at 300—400 kg/ha/yr (FAO 1966). Due to this low yield of local Hevea plant material in Nigeria, massive introductions of improved *Hevea* cultivars were made on the inception of the Rubber Research Institute of Nigeria (RRIN).

This paper reports the results of seedling growth vigour of Nigerian *Hevea* collections obtained from the Southern rubber growing belt of the country. The genetic variance of growth parameters from the chosen provenances were compared with a well improved *Hevea* cultivar.

Materials and Method

Nine population samples were collected from the rubber growing belt of Nigeria; this belt corresponds with the forest region of the country. Sampling was heavier in Bendel State since it is the area that contributes about 65% to the total rubber production in Nigeria. The locations of the seed collections are given in *Figure 1.*

Pre-germinated seeds were sown in the nursery in 6-seedling provenance 4 row-plots at a spacing of 100 × 80 cm. Sowing was done on September 20, 1978. Rock phosphate fertilizer was applied before the seeds were sown.

Provenance row-plots with a control clone, RRIM 600 were established in complete blocks with three replications. Individual provenances were assigned at random to the row-plots.

The first measurement of seedling height and diameter were made in December, 1978 and measurements were recorded at monthly intervals thereafter. All measurements were taken from ten seedlings each from two replicates and selected from the middle row-plots. The height was recorded from ground level to the stem apex for each seedling; while the diameter was measured at 10 cm from the ground with a calliper. The measurements continued until the 14th month after planting. For leaf area two leaves were collected from each sample seedling and the leaf area was obtained by using the central leaflet only and the product of the measurement of length times widest width. Highly significant correlations were reported between plan imeter leaf area and the product of legth × breath; secondly,the area of the central leaflet was found to be highly correlated to the area of the entire trifoliate leaf (Waidyanatha and Goonasekera 1975). For above ground (top) dry matter two leaves from each of the ten middle sample seedlings were collected from two replicates, dried in the oven at 70° C for 48 hours to constant weight. For the statistical analysis all the parameters were transformed to natural logarithms to remove proportionality

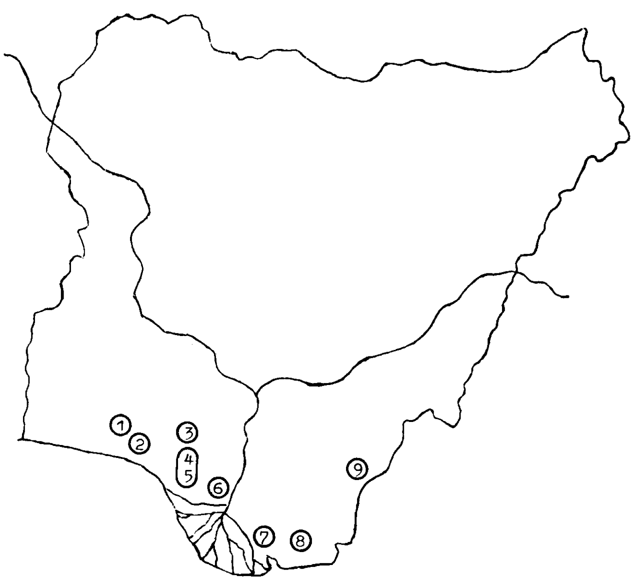

Figure 1. — Map of Nigeria showing the nine collection sites of the Hevea germplasm.

Key: 1: Araromi, 2: Aiyesan, 3: Okhuo, 4: Iyanomo, 5: Ajagbodudu, 6: Urhonigbe, 7: Elele, 8: Akwete, 9:Ikom between standard deviation and means (SNEDECOR and COCHRAN 1974, p. 329).

Results and Discussion

The seedling growth vigour as measured by height and diameter at 3,9 and 14 months is shown in *Table 1.* The variability between seedlings within each provenance population was high at the first (3 months) measurement and decreased gradually with increase in age of seedlings. Variability was higher for stem diameter. Variability within Clone RRIM 600 for diameter and height was constant irrespective of seedling age. Uniformity between RRIM 600 seedlings was excepted since the cultivar would have more homozygous loci for the characters measured than

Table 1. — Mean stem diameter,height (cm) and coefficients of variation of seedlings at six monthly intervals starting from the 3rd month after planting.

Provenances	Age (months) 3	9	14
DIAMETER			
1. Akwete	0.27 (26.3)[a]	1.30 (21.5)	3.10 (22.5)
2. Ajagbodudu	0.33 (42.4)	1.11 (36.9)	2.87 (28.2)
3. Ikom	0.23 (39.1)	1.11 (27.9)	2.94 (21.4)
4. Okhuo	0.31 (32.3)	1.19 (19.3)	2.93 (21.5)
5. Urhonigbe	0.31 (25.8)	1.20 (14.2)	3.30 (13.9)
6. Elele	0.22 (31.8)	1.13 (26.5)	3.30 (26.4)
7. Iyanomo	0.25 (36.0)	1.13 (21.2)	2.88 (29.9)
8. Aiyesan	0.28 (35.7)	1.24 (24.1)	3.46 (26.0)
9. Araromi	0.31 (38.7)	1.15 (28.7)	3.06 (30.1)
10. RRIM 600 (Control)	0.30 (23.3)	1.36 (21.3)	3.13 (22.0)
HEIGHT			
1. Akwete	46.6 (17.6)	119.9 (19.1)	274.0 (21.5)
2. Ajagbodudu	51.4 (27.6)	108.3 (30.6)	206.1 (29.7)
3. Ikom	41.7 (31.9)	100.3 (31.5)	279.2 (22.0)
4. Okhuo	52.0 (18.3)	124.0 (20.0)	275.5 (23.0)
5. Urhonigbe	51.5 (23.5)	131.2 (16.5)	293.7 (14.8)
6. Elele	44.2 (27.4)	116.5 (21.8)	312.9 (24.8)
7. Iyanomo	45.9 (26.9)	118.6 (23.0)	261.7 (30.4)
8. Aiyesan	42.2 (16.8)	123.6 (20.9)	320.1 (25.9)
9. Araromi	50.0 (24.2)	112.4 (24.6)	272.6 (30.5)
10. RRIM 600 (Control)	52.7 (18.0)	132.3 (20.0)	273.6 (22.1)

a) Figures in bracket indicate coefficient of variation (%).

Table 2. — Linear regression equations for fitting seedling height (H) and diameter (D) to monthly intervals (M) using provenances that were most widely separated.

Provenance	Equation	r
Elele	$\log_e H = 1.597 + 0.081\ M$	0.99
Araromi	$\log_e H = 1.681 + 0.067\ M$	0.99
Okhuo	$\log_e H = 1.662 + 0.058\ M$	0.98
RRIM 600 (Control)	$\log_e H = 1.667 + 0.070\ M$	0.99
Elele	$\log_e D = 0.444 + 0.102\ M$	0.97
Araromi	$\log_e D = 0.488 + 0.092\ M$	0.97
Okhuo	$\log_e D = 0.478 + 0.092\ M$	0.98
RRIM 600 (Control)	$\log_e D = 0.491 + 0.095\ M$	0.98

the unselected Nigerian *Hevea materials*. However at the 14th month of planting the source material from Aiyesan was superior in both height and stem diameter.

A continuous monthly growth increase (*Figure 2* and *3* and *Table 2*) was obtained for all the source materials. An average correlation value r = 0.99 was obtained between monthly intervals and growth increase for four selected provenances for both height and stem diameter. The regression coefficients between the source materials differed slightly. The intercepts also were nearly identical. A valid prediction of stem diameter or height is therefore possible. This would help in predicting stem size before budding.

A summary of the growth parameters measured at the 14th month of planting is shown on *Table 3*, while the mean square values are shown on *Table 4*. The mean provenance effect was singnificant for only $\log_e$ leaf area. The source materials from Nigeria were significant for $\log_e$ top dry weight and $\log_e$ leaf area but not for $\log_e$ height and diameter. A comparison between Nigerian source material and the control for the four characters showed that a highly significant difference was present for $\log_e$ diameter while the other characters remained statistically nonsignificant. Apart from $\log_e$ stem diameter, the performance of the Nigerian source materials and the controi clone remained statistically identical. If information on seedling characteristics is anything to go by the unselected Hevea materials found in Nigeria appear to provide new opportunities for clonal selections for high yields. WYCHERLEY (1969) showed that selection for small-scale clone trials has been made largely on the vigour of seedling growth during the first year in the nursery. SUBRAMANIAM (1974)

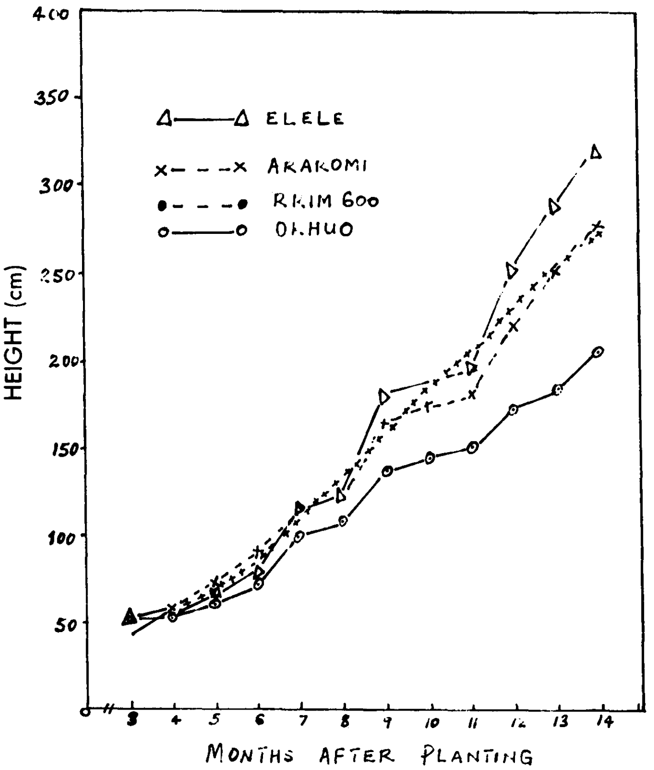

Figure 2. — Monthly growth (height) of Elele, Okhuo, Araromi and RRIM 600 nursery seedlings.

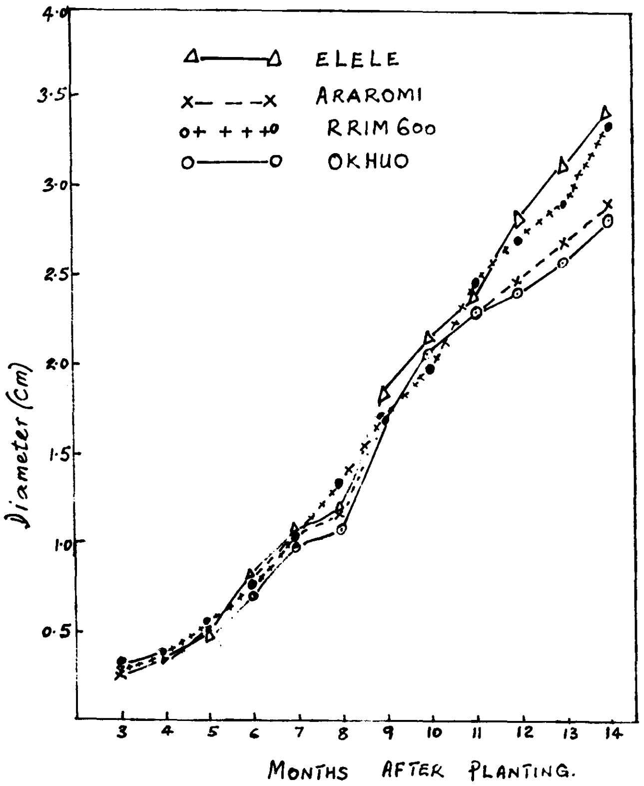

Figure 3. — Monthly growth (height) of Elele, Okhuo, Araromi and RRIM 600 nursery seedlings.

Table 3. — Mean squares from analysis of variance of ten sources of *Hevea* seedlings grown at the RRIN main station.

Sources of Variation	Log_e top dry weight	Log_e Height	Log_e Diameter	Log_e Leaf area
Replicate	0.0042	0.0019	0.00016	0.00971
Provenances	0.0078^{NS}	0.0071^{NS}	0.00324^{NS}	0.0098^{*}
Control V_s Local Material	0.0038^{NS}	0.0037^{NS}	0.0147^{**}	0.00003^{NS}
Among Local "	0.0082^{*}	0.0076^{NS}	0.0018^{NS}	0.01115^{**}
Error	0.00255	0.0027	0.00159	0.0026

NS = Not Significant.
*, ** Significant at 5 and 1% probability levels respectively.

reported a highly significant and negative relationship between nursery seedling diameter and clonal yield of the 1st and 2nd years of tapping while TAN and SUBRAMANIAM (1975) obtained a significantly positive correlation between growth vigour and yield for nursery seedlings. From the growth parameters one could identify two provenances i. e. Elele and Aiyesan as promising.

The inter-relations between the different growth parameters (height, diameter, leaf area and top dry weight) was examined in order to identify a common growth parameter that may be used for future selection *(Table 5).* The phenotypic correlations showed that height was positively correlated with diameter, leaf area and top dry weight. Stem diameter was positively and not significantly correlated with leaf area and top dry weight. The relationship between leaf area and top dry weight was also positive and not significant. This lack of significance could also have been due to small sample size. Since height was more difficult to measure, stem diameter would suffice as a measure of growth vigour. This has been suggested also by JAYASEKERA and SENANAYKE (1971), though the negative relationship between nursery stem diameter and yield of field plantings (SUBRAMANIAM 1974) poses a problem of the direction of selection.

The height and diameter of plants at the 3rd month after planting were compared with the height and diameter measurements taken at the 9th and 14th month after planting *(Table 6).* Positive correlations were obtained bet-

Table 4. — Summary of mean top dry weight leaf area diameter and height of ten provenance seedlings at the 14th month of planting.

Provenance	Top dry weight (g)	Leaf area (sq. cm)	Diameter (cm)	Height (cm)
1. Akwete	22.5	233.5	3.10	274.6
2. Ajagbodudu	17.5	161.5	2.87	206.2
3. Ikom	22.5	233.1	2.94	279.2
4. Okhuo	20.0	231.5	2.94	249.2
5. Urhonigbe	27.5	256.6	3.30	292.8
6. Elele	22.5	315.7	3.30	313.9
7. Iyanomo	24.5	231.5	2.87	261.7
8. Aiyesan	27.5	245.0	3.45	320.1
9. Araromi	20.0	206.8	3.06	272.6
10. RRIM 600 (Control)	20.0	221.1	3.13	243.9

Table 5. — Correlation coefficient between height, diameter, leaf area and top dry weight of seedlings at the 14th month of planting.

	Diameter	Leaf area	Dry weight
Height	0.886**	0.822*	0.775*
Diameter	-	0.658	0.674
Leaf area	-	-	0.550
Dry weight			-

Table 6. — Correlation coefficient of early stages with subsequent stages of growth for height and diameter.

Variables	Correlations
Height (3rd month) x Height (9th month)	0.466
x Height (14th month)	-0.489
Height (9th month) x Height (14th month)	0.360
Diameter (3rd month) x Diameter (9th month)	0.236
x Diameter (14th month)	-0.126
Diameter (9th month) x Diameter (14th month)	0.382

ween the 3rd and 9th and between the 9th and 14th months of planting for the two parameters. A negative correlation was obtained between the 3rd and 14th month of planting. The negative correlation might be due to an increased improvement in performance of source materials that had an unfavourable beginning. A weakening in correlation between early and later nursery vigour measurements have also been reported by SENANAYAKE *et al.* (1975), though negative correlations were not obtained.

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Chemogenetic study of phenolic compounds extracted from loblolly pine (Pinus taeda L.) needles[1])

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Summary

The objectives of this study were to examine the variation of phenolic constituents of pine needles among selfed progenies of loblolly pine and to determine the inheritance of phenolic constituents in loblolly pine needles. Most of the compounds found in the grafts were found in the selfed progenies. Four needle constituents showed segregation patterns in the selfed families. The observed segregation ratios of compound 53 in the selfed progenies fit a single gene hypothesis best. The inheritance patterns of the other three compounds are not clear from this study. Compound 53 was identified as dihydrokaempferol 7-0-glucoside by UV, NMR and mass spectra. Because dihydrokaempferol 7-0-glucoside might be a precusor of taxifolin 7-0-glucoside whose aglycone has been shown to inhibit the growth of a variety of pathogens, either compound could be correlated with disease resistance.

Key words: flavanoids, dihydrokaempferol, phenolics, grafts, selfs, thin-layer chromatography.

Zusammenfassung

Der Zweck dieser Untersuchung war, die Variation von phenolischen Bestandteilen in Kiefernnadeln von Selbstungen von *Pinus taeda* zu beschreiben und die Vererbung dieser phenolischen Stoffe zu bestimmen.

Die meisten in den Pfropfreisern vorhandenen Stoffe waren auch in den Selbstungen vorhanden. Vier der Inhaltsstoffe zeigten in den Selbstungen Aufspaltungen. Die beobachteten Spaltungsverhältnisse von Substanz 53 in den Selbstungen deuten am besten auf die Ein-Gen-Hypothese hin. Die Vererbungsmodi der anderen drei Stoffe waren nicht eindeutig.

Substanz 53 wurde mit Hilfe von UV, NMR und Massenspektroskopie als Dihydrokaempferol 7-0-Glucosid identifiziert. Weil Dihydrokaempferol 7—0-Glucosid eine Vorstufe von Taxifolin 7-0-Glucosid sein könnte, deren Aglycone das Wachstum verschiedener Pathogene hemmt, könnte diese Substanz mit der Krankheitsresistenz zusammenhängen.

Introduction

In recent years, many biochemicals, such as phenols, terpenoids (VON RUDLOFF 1975; SQUILLACE 1976), enzymes (HARE and SWITZER 1969; YANG *et al.* 1977), and DNA (MIKSCHE and HOTTA 1977) have been used in genetics studies. Because of their chemical complexicity, variable occurrence among species and ready detection in plant extracts as complex patterns of spots on two-dimensional chromatograms, phenolic compounds have often been used for the verification of species (HANOVER and WILKINSON 1970), races (FROST *et al.* 1977), cultivars (GRANT 1973), and hybrids (HOFF 1968), for introgression studies (DUNCAN 1975) and for studies of genetic differences in disease resistance (TJIA and HOUSTON 1975; NOMURA and KISHIDA 1978).

If a specific biochemical trait can be detected at an early age and is correlated with disease resistance, it can be of considerable value as a mean of indirect selection for disease resistance. Phenolic compounds may be particularly useful in this respect (KAUFMAN *et al.* 1974).

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