

Latex Yield of Rubber (*Hevea brasiliensis* Muell Argo) as Influenced by Clone Planted and Locations with Varying Fertility Status

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ABSTRACT

This study evaluated the latex yield of rubber (*Hevea brasiliensis* Muell Argo) as influenced by the type of clone planted and locations with varying fertility status in Cross River State, Nigeria. Results showed that the soils of the three locations were generally acidic (pH range 4.37 - 4.54) and sandy (75.6 - 82.6%) & low in organic carbon & macro-nutrients. This resulted in low latex yields of the clones. However, the location (Akim Akim) that had comparatively higher nutrient status improved the latex yield, suggesting that fertility status of soil has some influence on rubber latex yield. PRIM600, planted between the clones, produced significantly ($P < 0.05$) greater latex (2.01 t ha⁻¹) than PRI07 (1.45 t ha⁻¹) irrespective of location. The successful continuous cultivation of rubber in these locations would therefore require adoption of appropriate and relevant soil management practices.

Key Words: Rubber clone; Soil fertility; Latex yield; Locations

INTRODUCTION

The economic significance of Para rubber (*Hevea brasiliensis* Muell Argo), a member of the Euphorbiaceae family, had long been recognized (Purseglove, 1987) because of its ability to produce latex. Although it can thrive on a wide range of environment, it however does well, where the temperature is high, moisture adequate and in a fertile soil. Beside these factors, the productivity of the crop is also influenced by the type of clone used. This perhaps explains why it is opined that clones and soils are major factors that influence both the growth and productivity of rubber trees (Opeke, 1987).

Wood (1986) reported that among the factors affecting rubber productivity, clones type has been the most limiting factor. Similarly, Wycherley (1963) stated that soil constitutes the major aspects of the environment that greatly affect the growth and productivity of rubber trees. FELDA (1989) observed that poor plant growth might be brought about as a result of inappropriate choice of planting location. Opeke (1987) noted that rubber does well on deep, porous, red-clay top soil with sandy sub-soil. It could therefore be inferred that the productivity level of rubber is influenced by interactive effects of clones and soil fertility status.

Previous studies (Lundgren, 1978; Chijioke, 1980) have indicated that soil suffers a considerable depletion of fertility as a result of monoculture of industrial and economic tree crop species. In view of this, Benton-Jones (1985) stated that one of the major technological practices is the use of soil test and plant analysis to assist farmers identify and correct soil fertility problem.

Chijioke (1980) stated that the extent and gravity of soil depletion depend largely on the growth rate of the species planted. The ultimate use and the biological, physical and chemical nature of soils under rubber trees in the warm, high rainfall areas of Nigeria is particularly due to the enormous nutrient removal in latex. Amalu (1991) opined that the immobilization of nutrients in the tree trunks and the use of little or no manures in rubber plantation are the likely reasons for limited plantation of this species. With this background, this study assessed the effect of location (site) with varying fertility status on the productivity of two rubber clones.

MATERIALS AND METHODS

The study was conducted between June 2000 and March 2001 in Cross River State. The State is located between latitudes 4.8' and 4.47' N and longitudes 8.17' and 8.22' E. The state has a bi-modal pattern of rainfall with the first rainy season commencing from March - July, a dry spell in August followed by second rainy season in September - November. The mean annual rainfall is 270.5 mm temperature is 30.9°C and relative humidity is 84.5%.

The experiment was laid out in a randomized complete block design with a split-plot arrangement. The main treatments were two rubber clones; PRIM600 and PR107 planted by Pamol (Nigeria) Limited in 1985, while the sub-treatments were three different locations (sites) viz: Ikot Ansa (location 1), Ikot Omin (location 2) and Akim Akim (location 3). Each location had three replicates with 400 stands per replicate. Before the commencement of the study,

Table I. Latex yield of Rubber trees (t ha⁻¹) as affected by clones and location

Clone	Location			Mean
	Ikot Ansa	Ikot Omin	Akim Akim	
PRIM600	1.59	2.17	2.26	2.01
PR107	1.31	1.21	1.84	1.45
Mean	1.45	1.69	2.05	

LSD (P < 0.05): for Clone = 0.18,

For locations = 0.09

composite soil samples were collected from these locations for particle size distribution and chemical analysis at 0 - 40 cm depth. The following soil parameters were determined: soil pH by the glass electrode pH meter in 1:1 soil to water suspension; organic carbon by the dichromate wet oxidation method (Walkey - Black, 1934); total N was determined by Kjeldahl digestion and distillation method as described by Udo and Ogunwale (1978). Available P was determined by the Bray's P1 method (Bray & Kurtz, 1945), while the exchangeable bases were extracted by the method described by Jackson (1964) using neutral ammonium acetate. The flame photometer was used to determine K, Na and Ca, while Mg was read on the atomic absorption spectrophotometer. Exchangeable acidity was determined by titration method, while CEC was determined as the sum of exchangeable bases and exchangeable acidity. Base saturation was obtained as ratio of the total exchangeable bases to the effective cation exchange capacity. The particle size distribution was determined by the Bouyoucos (1951) method. Twenty rubber stands were randomly sampled per plot giving 60 stands per replicates for each clone in each location. Latex yield from each plot was collected 11 times per month depending on the cycle of the month concerned. Latex yield data were converted from litres to kg using a correction factor of 0.375 approved for dry rubber constant (Awalele, 2002, personal communication), followed by

conversion of values to tons per hectares (t ha⁻¹). The latex yield of the two rubber clones and the soil parameters were subjected to analysis of variance (Gomez & Gomez, 1984) and means compared using LSD (P < 0.05).

RESULTS AND DISCUSSION

Latex yield and soil fertility status of location used. The clone planted and the location used had significant influence (P < 0.05) on the rubber latex yield (Table I). PRIM 600 Clone produced the highest latex yield per tree than PR107 irrespective of the location (Table I). The overall mean across the three locations were 2.01 and 1.45 t ha⁻¹ for PRIM600 and PR107 clones, respectively. Among the locations, Akim Akim supported latex yield production most irrespective of the clones used while the lowest latex production was observed in Ikot Ansa location for RRIM600 clone (1.59 t ha⁻¹) and in Ikot Omin for PR107 clone (1.31 t ha⁻¹).

The significant difference observed between the two rubber clones is in line with the findings of Wycherley (1971), who reported that clones vary greatly in response to soil fertility, some being almost sterile and some very prolific. The locations varied in soil fertility status (Table II) and this influenced the latex production as plant cultivars are known to responds differently to environmental conditions.

Soil status and clone/soil interaction. Analysis revealed that the soils were generally acidic (Table II). The pH was 4.37, 4.59 and 4.45 for Akim Akim, Ikot Omin and Ikot Ansa, respectively. Organic carbon, total N, available P and CEC were generally highest in Akim Akim soil and lowest in Ikot Ansa soil except for available P. The exchangeable bases did not show a clear trend (Table II) but Ikot Omin and Akim Akim soils had higher values for the exchangeable bases as well as for base saturation. The

Table II. Soil physico-chemical properties of the experimental locations (sites)

Sample locations	pH	EC (dS m ⁻¹)	ORGC (%)	Total N (%)	AVP (mg kg ⁻¹)	Ca (cmol kg ⁻¹)	Mg (cmol kg ⁻¹)	Na (cmol kg ⁻¹)	K (cmol kg ⁻¹)	EA (cmol kg ⁻¹)	ECEC (cmol kg ⁻¹)	B.Sat. (%)	Sand (%)	Clay (%)	Silt (%)	Textural class
Location 1 (Ikot -Ansa)																
RRIM600																
PR107	4.20	0.05	0.16	0.03	7.99	1.20	0.50	0.04	0.11	1.80	3.66	50.82	74.6	20.6	4.8	SL
	4.69	0.04	0.17	0.03	6.66	1.00	0.04	0.05	0.08	1.90	3.43	44.61	82.6	16.6	0.8	SL
MEAN	4.45	0.04	0.16	0.03	7.33	1.10	0.45	0.05	0.09	1.85	3.55	47.72	78.6	18.6	2.8	
Location 2 (Ikot -Omin)																
RRIM600																
PR107	4.68	0.03	0.24	0.04	8.66	1.20	0.40	0.06	0.09	1.40	3.15	55.55	78.6	20.6	0.8	SL
	4.50	0.04	0.24	0.03	5.33	2.80	0.40	0.05	0.14	1.60	4.99	67.94	72.6	26.6	0.8	SCL
MEAN	4.59	0.04	0.24	0.03	6.99	2.0	0.40	0.06	0.12	0.50	4.07	61.94	75.6	23.6	0.8	
Location 3 (Akim - Akim)																
RRIM600	4.44	0.03	2.27	0.05	10.66	2.00	0.80	0.05	0.09	2.03	4.97	59.15	82.6	16.6	0.8	SL
PR107	4.30	0.06	0.79	0.04	11.33	1.40	6.60	0.05	0.10	1.70	3.85	55.84	82.6	16.6	0.8	SL
MEAN	4.37	0.05	1.53	0.06	10.99	1.10	0.70	0.05	0.09	1.87	4.41	57.50	82.6	16.6	0.8	

LSD (P < 0.05)

For Clone: 0.09 NS 0.41 NS 2.31 0.60 NS NS NS 0.19 NS 4.52 5.10 4.4 NS

For Location: 0.06 NS 0.05 0.01 0.35 NS 0.22 NS NS 0.33 0.50 8.21 3.4 4.1 NS

NOTE: Values are means from the three replicates, SL and SCL = Sandy Loam and Sandy Clay Loam respectively, NS = Not significant

particle size analysis revealed that Akim Akim soil was higher in sand fraction (82%) compared to Ikot Omin and Ikot Ansa soils, which had higher concentrations of clay (23.6%) and silt (2.8%).

The general fertility status of these soils was low, which explains the low rubber latex yields observed. The sand fraction values of 75.6 - 82.6% were higher than the desirable range of texture (50 - 70%) for rubber plant (RRIM, 1977). This implies higher porosity, which could enhance nutrient leaching and reduce water holding capacity of the soil. The total N and available P values were below the critical limits of 1% (Pushparajah *et al.*, 1983) and 11.0 mg kg⁻¹ (Chan *et al.*, 1984). Therefore the soils could not fully support rubber growth and latex yield. This study revealed that where the fertility was relatively better (Akim Akim), rubber latex yield was also higher (Tables I & II).

Studies have demonstrated that where K, Ca, Mg values below 0.2, 5 and 1 cmol kg⁻¹ respectively, the rubber growth and latex yield were also low (Tinker, 1967; Taylor & Pholen, 1970; Enwenzor *et al.*, 1988; Amalu, 1992). This study revealed that Akim Akim had relatively better soil fertility status and it produced higher latex yield and supports the observations made above as well as substantiated the fact that rubber latex yield is influenced by soil fertility. Therefore, it is pertinent to manage these soils well so as to increase their fertility to support the growth of rubber. However, clone RRIM600 performed better than PRI07 irrespective of the location, indicating the former is more favorable for the agro-ecology.

CONCLUSION

The soils of the three locations are generally acidic, sandy and low in organic carbon and macro-nutrients. The continuous use of the sites for rubber cultivation would therefore require application of some soil amendments and adoption of appropriate soil management practices. Such practices include use of organic and inorganic fertilizers, encouraging cover crop planting and mat-layer formation as well as planting productive clones such as RRIM600.

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