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HERITABILITY ESTIMATES OF TREE DRYNESS AND CORRELATION WITH LATEX PARAMETERS IN *HEVEA BRASILIENSIS*

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ABSTRACT

Eleven clones of Hevea brasiliensis *were evaluated for incidence of tree dryness and four latex parameters at three locations. There was significant clonal variation in incidence of tree dryness with heritability estimates of 0.08 and 0.05 in two locations. Contingency test of tree dryness and the four latex parameters* viz. *initial volume, final volume, initial flow rate and plugging index was significant with significant correlation between tree dryness and initial volume, final volume and initial flow rate. The breeding and agronomic implications of low heritability of tree dryness and significant correlation with three latex parameters are discussed.*

Key words: heritability, latex parameters, root stock, tree dryness

INTRODUCTION

Hevea brasiliensis has been exploited for latex for more than a century. One of the earliest syndromes of *Hevea* discovered is tree dryness and studies on effective prevention, control and treatment are in progress (IRRDB, 1997). Tree dryness is the cessation of latex flow from the tapping panel even after several cuts. Genetic and external factors have been implicated for incidence of tree dryness (Sivakumaran *et al*, 1988, Olapade & Igeleke, 1989, Sivakumaran & Haridas, 1989).

Several latex parameters have been proposed for study in order to detect the changes in latex parameters before the onset of tree dryness (Sethuraj, 1989). The influence of genetic factors has been shown only through clonal variation and intra-clonal variation is a common occurrence in the incidence of tree dryness. The cause of intra-clonal variation remains unresolved. Sometimes, the effect of rootstock is suggested as a reason for high intra-clonal variation and this has not been confirmed. It is even unlikely that rootstock effect on tree dryness is significant (Sivakumaran *et al.*, 1994). This study was therefore designed to estimate the heritability index of tree dryness. Heritability estimate will assist in showing the proportion of total inter-

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clonal variation that is due to the effect of genes. The correlation between tree dryness and latex parameters is also reported.

MATERIALS AND METHODS

The experimental clones were C-series of the RRIN developed clones. Ten of these clones and an exotic clone - RRIM 600 were planted at three locations in the rubber growing belt of Nigeria in 1979. The locations were Akwete in Abia State, Etche in Rivers State and Okhuo in Edo State.

The plantations were opened for tapping in 1989 with ½ S d/2 system and without stimulation. Panel scoring was carried out five years after opening as normal trees [N] and dry trees which were scored as M_1, M_2, M_3 and M_4. M_1 refers to dryness on 10% of the cut, M_2 with dryness on 10-50% of the cut, M_3 with dryness on 50-90% of the cut and M_4 for $\geq$ 90% dryness. For the purpose of heritability estimate, M_1, M_2 and M_3 were regarded as partially dry and M_4 as completely dry. Percent partial dryness and percent complete dryness were calculated. Total dryness in each clone was calculated as the sum of partial and complete dryness.

Data on latex parameters were taken in two locations *viz.* Etche and Akwete. The latex parameters studied were volume of latex five minutes after opening the cut [V_1] and volume of latex collected at cessation of flow of latex [V_2]. Latex parameters also included in this study were initial flow rate [IFR] and plugging index [PI]; these were obtained as:

$$IFR = \frac{V_1}{5} \text{ [ml/min]}$$

$$PI = \frac{IFR}{V_2} \times 100$$

The following analyses were carried out:

1. Percent partial dryness and percent complete dryness were transformed using arc-sine transformation.
2. Locational and combined factorial analysis of tree dryness heritability [h^2] estimates.
3. X^2 (chi-square) test of contingency of tree dryness and latex parameters using three clones with occurrence of M_1, M_2 and M_3 types of dryness and N (normal trees).
4. Correlation between latex parameters and tree dryness. For the purpose of correlation analysis, tree dryness was scored as: N = 0, M_1 = 2, M_2 = 4 and M_3 = 6.

RESULTS AND DISCUSSION

There was significant clonal variation in the locational and combined analysis of incidence of tree dryness (Tables 1, 2 and 3). This is in agreement with previous reports (Commere *et al.*, 1989, Olapade & Igeleke, 1989). The interaction effects were also significant (Tables 1 and 2). This means that recommendation of clones based on combined analysis will be misleading. Location/environment specific recommendation will therefore be appropriate in this study.

Table 1. *Mean squares [MS] of tree dryness in locational trials*

		MS/Location		
S.V.	d.f.	Akwete	Etche	Okhuo
Replicate	2	179.63	7.41	58.51
Dryness	1	0.42	800.33**	2214.33**
Clone	10	409.10*	79.62*	127.46*
Dryness x clone	10	604.07**	59.87	108.10
Error	42	131.83	38.58	61.87
h2		-0.33	0.08	0.05

*, **: Significant at p = 0.05 and p = 0.01 respectively [F - test].

Table 2. *ANOVA for combined analysis of tree dryness*

S.V.	d.f.	SS	MS
Replicate	2	10.80	5.40
Dryness	1	1859.90	1859.90**
Location	2	1444.13	722.07**
Clone	10	2099.75	209.98**
Dryness x location	2	1155.09	577.55**
Dryness x clone	10	2677.08	267.71**
Location x clone	20	4023.19	201.16**
Dryness x location x clone	20	5038.83	251.94**
Error	130	10659.80	82.00
H2			-0.004

** Significant at p = 0.01 [F – test]

The significant clonal variation suggests the possibility of selecting for low incidence of tree dryness. In this regard, two clones *viz.* C 162 at Akwete and C 145 at Etche can be recommended as clones that manifest low incidence of tree dryness. The significant clone x location interaction was clear with C 162 which had no incidence of tree dryness at Akwete but was among the clones with high incidence of tree dryness of 23.83% and 42.34% at Etche and Okhuo respectively (Table 3). The same trend was recorded for C 145 with zero incidence of tree dryness at Etche but was among the clones with high incidence of tree dryness of 66.67% and 53.34% at Akwete and Okhuo respectively (Table 3). Variable response of RRIC 101 in incidence of tree dryness at different locations has been reported (Chandra & Yapa, 1989). Despite significant interactions, C 150 had relatively low incidence of tree dryness of 3.70%, 4.17% and 12.07% at Etche, Akwete and combined analysis respectively (Table 3). C 150 is likely to possess potentials for broad-spectrum low incidence of tree dryness. Population mean incidence of tree dryness was 37.52%, 16.76%, 15.14% and 23.14% at Okhuo, Akwete, Etche and pooled data respectively (Table 3). The environmental and management practices that led to relatively high incidence of tree dryness at Okhuo will be further studied.

Table 3. *Mean separation for percent total dryness*

	*Location			
Clone	Akwete	Etche	Okhuo	*Combined
C 145	66.67^{a}	0.00^{b}	53.34^{ab}	40.00^{a}
C154	25.00^{b}	19.17^{ab}	56.66^{a}	33.61^{ab}
C 76	16.39^{b}	12.17^{b}	35.00^{bc}	21.19^{bc}
C 202	15.93^{b}	16.67^{b}	12.34^{c}	14.98^{bc}
C 143	15.74^{b}	19.05^{ab}	46.66^{abc}	27.15^{bc}
C 159	12.50^{b}	15.28^{b}	35.00^{bc}	20.93^{bc}
C 83	12.22^{b}	43.98^{a}	26.34^{bc}	27.51^{bc}
RRIM 600	8.33^{b}	4.17^{b}	30.00^{bc}	14.17^{c}
C 163	7.41^{b}	8.47^{b}	46.66^{ab}	20.85^{bc}
C 150	4.17^{b}	3.70^{b}	28.34^{bc}	12.07^{c}
C 162	0.00^{b}	23.83^{ab}	42.34^{abc}	22.06^{bc}
+ Population Mean	16.76^{y}	15.14^{y}	37.52^{x}	23.14

* = Mean followed by different letters in each column are significantly different at p = 0.05 [DMNRT].

+ = Means followed by different letters in the row are significantly different at p = 0.05 [DMNRT]

Heritability estimates were very low at - 0.33, 0.05, 0.08 and - 0.004 for Akwete, Okhuo, Etche and combined data respectively (Tables 1 and 2). Low heritability is an indication of the high level of environmental influence on the incidence of tree dryness. This is responsible for the high intra-clonal variation often observed within a clone in the incidence of tree dryness. The status of a clone for genetic tolerance or susceptibility can therefore be established only when such a clone has been evaluated in a wide range of environmental conditions. Also, since geneticimprovement in a breeding cycle is a function of heritability (Falconer, 1986), several cycles of selection will be required to improve on genetic tolerance to tree dryness in a breeding population. Until such a long term breeding effort is achieved, agronomists have to develop appropriate management techniques to minimise the occurrence of tree dryness in the field. In addition, plant breeders should screen a large number of clones to enhance genetic variability, heritability and genetic progress of selection for low incidence of tree dryness.

The contingency tests of tree dryness and latex parameters were significant in two clones (C 202 and C 162) and in the combined analysis (Table 4). In addition, initial volume, final volume and initial flow rate had significant correlation with tree dryness at $\Gamma = -0.64$, -0.53 and -0.64 respectively (Table 5). This suggests that there is a tendency for latex parameters to change in response to the factors responsible for the initiation and severity of tree dryness. Screening of trees before the onset of tree dryness is therefore recommended. By such screening, it will be possible to detect the changes in these latex parameters before dryness is observed. It may therefore be possible to predict the threat of tree dryness in a tree and appropriate field management techniques can be applied to avoid panel dryness.

Table 4. *Contingency tests of tree dryness and latex parameters*

Clone	X2
C 162	31.97**
C 202	21.26*
C 83	13.04
Combined	103.51**

*, **: Significant at p = 0.05 and p = 0.01 respectively

Table 5. *Correlation coefficient (r) between tree dryness and latex parameters across the three clones [C 162, C 202, C 83]*

Characters	R
Tree dryness and V1	-0.64*
Tree dryness and V2	-0.53*
Tree dryness and IFR	-0.64*
Tree dryness and PI	0.05

*: Significant at p = 0.05 [t-test]

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