Genetics and Molecular Biology, 27, 2, 242-244 (2004)

www.sbg.org.br

Short Communication

Clonal stability of tree dryness in *Hevea brasiliensis* Muell. Arg.

K.O. Omokhafe

Rubber Research Institute of Nigeria, Benin City, Nigeria.

Abstract

Clonal stability of tree dryness was evaluated in eleven clones of *Hevea brasiliensis* at the Rubber Research Institute of Nigeria. The experimental design was the randomized complete block with three replicates and ten trees per replicate. The clones were evaluated in three locations. Four stability parameters were applied. The stability parameters were: environmental variance, regression index, variance due to regression, and Shukla's stability variance. Clone C 202 was outstanding for clonal stability and could be useful for further studies and genetic improvement of tree dryness. Other four clones (C 76, C 150, C 159 and RRIM 600) were also stable.

Key words: *Hevea*, tree dryness, clones, stability.

Received: January 20, 2003; Accepted: December 16, 2003.

Introduction

The main product obtained from *Hevea brasiliensis* is latex, which has been the main focus of genetic improvement ever since commercial exploitation of natural rubber started (Pushparajah, 1995). Tree dryness is the cessation of the latex flow from the tapping cut, drastically reducing the volume of latex produced. Portions of the cut or the entire cut can dry out. The two conditions are referred to as partial and complete dryness, respectively (Omokhafe, 2001).

It has been suggested that tree dryness is a syndrome arising from a number of dysfunctional factors in the plant (Das *et al.,* 1998), and significant genotype x environment interaction has been reported for it (Omokhafe and Aniamaka, 2000). Intra-clonal variation, which obscures clonal character, is a common feature in the incidence of tree dryness in *Hevea brasiliensis* (Sivakumaran *et al.,* 1994).

Stability is a measure of clonal performance over a number of environments. Such environmental differences range from minor changes among trees in the same plot, as in intra-clonal variation, to differences in time and location. According to Singh and Gupta (1998), clonal stability is the cumulative effect of allelic interactions. Stable clones would be required to minimize the hazards associated with effects of intra-clonal variation and significant genotype x environment interaction. This study was therefore designed to estimate clonal stability of tree dryness in *Hevea brasiliensis* and appoint the stable clones for further studies.

Send correspondence to K.O. Omokhafe, E-mail: kenomokhafe2001@yahoo.com.

Materials and Methods

Eleven clones of *Hevea brasiliensis* were evaluated for tree dryness at experimental sites of the Rubber Research Institute of Nigeria (RRIN). The locations were Okhuo (6° N, 6° E) in Edo State, Akwete (5° N, 7° E) in Abia State, and Etche (4.5° N, 6.5° E) in Rivers State. The experimental design was the randomized complete block of three replicates per clone and ten trees per replicate.

The eleven clones consisted of ten clones developed at the RRIN and one clone developed in Malaysia. The clones were planted in the three locations in 1979 and opened for tapping in 1989. The tapping frequency was 1/2S, d/2 without stimulation, as described by Aniamaka and Olapade (1990). The trees were evaluated for tree dryness in 1994. Each tree was scored as dry (if dryness was observed) or normal (if there was no dry portion).

Percentage incidence of tree dryness in each clone was transformed using arc-sine transformation and evaluated for stability using four stability parameters. The four parameters applied were environmental variance (S_i), regression index (b_i), variance due to regression (S^2_{bi}), and Shukla's stability variance ($\hat{\sigma}^2_i$), as described by Lin *et al.* (1986), Finlay and Wilkinson (1963), Eberhart and Russell (1966), and Shukla (1972), respectively. The degrees of freedom for stability variance analysis were determined as described by Eberhart and Russell (1966) and Singh and Chaudhary (1977). Clonal stability values due to S_i and b_i

were tested using t-statistics, while values of S^2_{bi} and $\hat{\sigma}^2_i$ were evaluated using the F-test.

Results and Discussion

There was significant clonal variation for tree dryness (Table 1), which is in agreement with a previous study (Omokhafe, 2001). However, low heritability values of tree dryness among the eleven test clones have been reported (Omokhafe and Aniamaka, 2000). The strong influence of the environment on clonal variation was manifested through the significant clone x environment interaction (Table 1). Similarly, Vijayakumar *et al*. (2000) reported the influence of environmental factors on the incidence of tree dryness. Typical clonal phenotypes could be determined depending on clonal stability.

The significant clone x environment interaction suggests a significant difference in clonal tree dryness across the three locations. The extent of such clonal variation, which is a measure of instability, was determined by applying stability parameters.

The four stability parameters applied belong to different classes. Environmental variance is based on bulk phenotypic variance, while Shukla's stability variance partitions the total clone x environment interaction into clonal components. The regression index measures the phenotypic linear response of a clone to the environment, so that a clone is rated unstable when the regression index (b_i) is significantly different from unity. The variance due to regression provides a breakdown of the total non-linear portion of the clone x environment interaction into the clonal components. The application of the four stability parameters minimizes the bias of a single parameter (Lin *et al.,* 1986)

Table 1 - ANOVA for stability of tree dryness in *Hevea brasiliensis*.

Source of variation	d.f.	SS	MS
Total	32	9813.652	na
Clone (Cl.)	10	19808.628	1980.863**
Location (Loc.)	2	3426.377	1713.189**
Cl. x Loc.	20	4248.814	212.441**
Average error	60		26.95

na: not applicable.
**: Significant at p = 0.01 (F-test).

Environmental variance was a strict stability parameter, as only one clone (C 202) was found to be stable (Table 2). The regression index was a weak parameter, since all the clones were presented as stable (Table 2). The other stability parameters (S^2_{bi} and $\hat{\sigma}^2_i$) were intermediate in stability rating and hence were used to complement environmental variance. Clone C 202 was therefore the most stable, followed by C 76, C 150, C 159 and RRIM 600 (Table 2). Other clones (C 83, C 143, C 145, C 154, C 162 and C 163) were relatively unstable for tree dryness. Since clonal stability is genetic (Singh and Gupta, 1988), the stable clones should be preferred for further studies on tree dryness. Very often, tree dryness is studied in relation to latex yield. In this regard, C 76 and C 150 would have an advantage, as both clones have been reported to be stable for latex yield (Omokhafe and Alika, 2003).

Acknowledgement

The author is grateful to the Director of the Rubber Research Institute of Nigeria (Mrs. M. U. Mokwunye) for her support. I am also grateful to the staff of the Plant Breeding Division and the Akwete sub-station (RRIN) for maintaining the field trials. The assistance of Mr. Benson

Table 2 - Clonal stability parameters of tree dryness in *Hevea brasiliensis*.

Clone	Parentage	Stability parameter			
		S_i	b_i	S^2_{bi}	$\hat{\sigma}^2_i$
C 76	RRIM 501 x HAR 1	7.01*	0.97	2.79	1.93
C 83	RRIM 600 x PR 107	9.19**	-0.16	498.25**	459.99**
C 143	RRIM 501 x RRIM 628	9.80**	1.34	16.12	25.65
C 145	- ditto -	20.37**	1.10	2113.40**	1058.20**
C 150	- ditto -	8.14*	1.13	0.19	3.01
C 154	- ditto -	11.65**	1.61	5.89	60.81
C 159	- ditto -	7.08*	0.97	8.68	4.91
C 162	- ditto -	12.25**	1.34	340.65**	188.06**
C 163	- ditto -	12.91**	1.78	10.48	99.84**
C 202	RRIM 600 x PR 107	1.34	-0.18	0.37	218.65**
RRIM 600	TJIR 1 x PB 86	8.01*	1.11	1.86	3.20

*, **: Significant at p = 0.05 and p = 0.01 respectively (t - test for S_i, F - test for $\hat{\sigma}^2_i$ and S^2_{bi}).

Onyeanakwe in the data collection is hereby acknowledged.

References

Aniamaka EE and Olapade EO (1990) Comparison of different methods of yield estimation in *Hevea brasiliensis*. Indian J Nat Rubb Res 3:98-101.

Das G, Raj S, Pothen J, Sethuraj MR, Sinha TP and Sen-Mandi S (1998) Status of free radical and its scavenging system with stimulation in *Hevea brasiliensis.* Plant Physiol and Biochem 25:47-50.

Eberhart SA and Russell WA (1966) Stability parameters for comparing crop varieties. Crop Sci 6:36-40.

Finlay KW and Wilkinson GN (1963) The analysis of adaptation in plant breeding programme. Aust J Agric Res 14:742-754.

Lin CS, Burns MR and Lefkovitch LP (1986) Stability analysis: Where do we stand? Crop Sci 26:894-900.

Omokhafe KO (2001) Preliminary investigation into tree dryness in *Hevea brasiliensis* by path analysis of tree dryness and latex parameters. Tropicultura 19:1-4.

Omokhafe KO and Alika JE (2003) Clonal stability of latex yield in eleven clones of *Hevea brasiliensis* Muell. Arg. Genet Mol Biol 26:313-317.

Omokhafe KO and Aniamaka EE (2000) Heritability estimates of tree dryness and correlation with latex parameters in *Hevea brasiliensis.* J Rubb Res Inst Sri Lanka 83:17-22.

Pushparajah E (1995) RRIM's achievements in production, research and development from 1925 to 1995. The Planter 71:571-587.

Shukla GK (1972) Some statistical aspects of genotype-environment components of variability. Heredity 29:237-245.

Singh RK and Chaudhary BD (1977) Biometrical methods in quantitative genetic analysis, Kalyani Publishers, New Delhi, India, 304 pp.

Singh SV and Gupta PK (1988) Phenotypic stability for tuber yield in potato (*Solanum tuberosum* L.) Indian J Genet 48:9-12.

Sivakumaran S, Leong SK, Ghouse M, Ng AP and Sivanadyan K (1994) Influence of some agronomic practices on tapping panel dryness in *Hevea* trees. IRRDB Workshop on Tree Dryness: 94-110.

Vijayakumar KR, Thomas KU and Rajagopal R (2000) Tapping. In: George PJ and Jacob CK (eds) Natural Rubber: Agromanagement and Crop Processing. Ananswara Printing and Publishing Company, Cochin, India, pp 215-238.