Plantation Crops Research and Development in the New Millennium (2002): 280-283

LONG TERM STABILITY IN YIELDING POTENTIAL OF CLONES OF *HEVEA BRSILIENSIS* IN TRIPURA

P.M. Priyadarshan, S. Sasikumar, R.B. Nair* and S.K. Dey

Rubber Research Institute of India, Regional Station, Agartala – 799 006, India

ABSTRACT

The yielding potential of 15 clones over ten years has been analysed utilizing Francis and Kannenberg's clustering method and Huehn's non-parametric stability statistic. Four clusters *viz.*, with high mean & low cv; low mean & low cv; and high mean & high cv were low mean high cv separated. RRII 105, RRIM 600 and PB 235 were adjudged in the first cluster as most stable clones over months/years. Though RRII 118, RRII 203 and RRIM 703 exhibited high cv, their high mean values shall be considered as desirable since it can form integral components of clone blending. These clones are more sensitive to environmental changes and adaptive to specific environment, since Tripura offers wide range of macro-environmental fluctuations over the months. However, the non-parametric method through ranking revealed GL 1, Harbel 1, PB5/51, PB 235 and PB 86 as the most stable clones with least values of $S_i^{(3)}$. These exercises rationalize PB 235 to be stable over months and years. Projected yield over the years placed PB 235, RRII 203,RRIM 703, RRIM 600 and RRII 118 in the order of hierarchy suitable to be evaluated in the planters' field.

Key words: coefficient of variation, GE interactions, potential clone, stability, non-parametric measures, specific adaptation.

INTRODUCTION

Studies on adaptability gains prominence while breeding crop species in non traditional environments. Adaptability of clones / genotypes is judged through stability (Crosa, 1990). Mainly three selection strategies can be followed for the assessment of stability of clones / genotypes under varied environments (Ceccarelli *et al.*, 1998). They are: a) select under optimum or near optimum environment, presuming that better genotypes express their superiority under limiting conditions also; b) when a target population is under several diverse environments, GE interaction are expected to be large and selection should be for specific adaptation through decentralized selection and c) alternate use of stressful and optimum conditions to select genotypes that yield well / perform better in both conditions.

Tripura presents a non-traditional environment for *Hevea brasiliensis* where the assessment of adaptability of clones becomes conspicuous while breeding for the specific environment (Priyadarshan *et al.,* 1998 a &b). Prudent stress factors prevailing in this state are low temperature, wind and *oidium* infestation. As such, fluctuations are also noticed in yielding trend in clones among months and years (Priyadarshan *et al.*, 2000). Yield evaluation in Tripura is being conducted under two sub-environments denoted as Regime I and II(Regime I = April to September and Regime II= October to January). While in Regime I the clones yield low, Regime II represents a high yielding period (Priyadarshan *et al.,* 1998b) . These fluctuations in yielding potential among clones can be assessed through GE interaction analysis.

The GE interactions can be judged through analysis of phenotypic stability. Stability estimates are classified as four types *viz.*, Type 1 with analysis of coefficient of variability (Francis and Kannenberg,1978); Type 2 where the stable genotypes fit a linear regression model and have a unit slope (Finlay and Wilkinson, 1963); Type 3 is through calculation of residual mean square of deviation from regression (Eberhart and Russell,

* Rubber Research Institute of India, Kottayam-686 009, India

1966) and Type 4 is based on a genotype's years-within-location mean square (Lin and Binns, 1991). In all these exercises, the genotype with least value is considered as most suitable. The aforesaid methods are of parametric type. However, non-parametric stability rating based on ranking was devised by Huehn (1990a). Among the aforesaid procedures for calculating stability estimates available in the literature, the methods extending equal importance to higher mean values and coefficient of variation (Francis and Kannenberg, 1978) and a non-parametric estimation through ranking of genotypes (Huehn,1990a) are seen to be useful tools in determining stability of perennial crops. Fifteen clones utilized for this study have been subjected to these analyses.

MATERIAL AND METHODS

The clone evaluation garden involving fifteen clones established in 1979 has been utilized for the study. This trial was established during 1979 at the Taranagar Farm of the Regional Research Station of the Rubber Research Institute of India at Agartala, India. (Location 91° 15" E; 23° 53'N; 30 MSL). The clones had their origin in India (RRII 5, RRII 105,RRII118, RRII 203), Malaysia (RRIM 600, RRIM 605, RRIM 703, PB 5/51, PB 86, PB 235, GI 1), Sri Lanka (RRIC 52, RRIC 105), Indonesia (GT 1) and Liberia (Harbel 1). Yield data was collected from individual trees in the form of cup coagulum. The tapping system followed was ½ S d/2 6d/7.

The classification of 15 clones in to four clusters (Francis and Kannenberg, 1978) is as follows: i) Cluster 1 : High mnean and low cv (most stable), ii) Cluster 2 : Low mean and low cv, iii. Cluster 3 : High cv and low mean, iv) Cluster 4 : High mean and high cv. The calculation of non-parametric stability estimate ($S_i^{(3)}$)was done by the formula of Huehn (1990 a and 1990b).
(= Sum of the absolute deviations of the r_{ij} 's from maximum stability expressed in $r_{i.}$ – units).

RESULTS AND DISCUSSION

In the first method utilized (Francis and Kannenberg, 1978), both mean values and co-efficient of variation (cv) were considered to form clusters. The cluster with high mean and low cv was considered as most stable and low mean and high cv as least stable. Clonal bifurcations undertaken are available in Table 1. The clones RRII 105, RRIM 600 and PB 235 are found to be most stable over a span of ten years. RRII 5, RRIC 52. GT 1 and Harbel 1 are seen to be least stable. The other high yielding clones (RRII 118, RRII203 and RRIM 703) are seen to be with high mean and high cv. The environmental mean yields over months (May to January) have been depicted against mean yield of respective clusters in Fig. 1. It may be seen that there is a clear divide between clusters that are high yielding and low yielding. Contrary to clustering method, the non-parametric measures of phenotypic stability through ranking revealed a different trend in stability among clones. GL 1, Harbel 1, PB 5/51 and PB 235 are seen to be stable over the years with least values of $S_i^{(3)}$ (Table 2).

Huehn (1990b) has worked out correlation between $S_i^{(3)}$ and classical stability parameters like environmental variance, ecovalence,

Table 1. Clusters drawn out of parametric stability analysis (Francis and Kannenberg, 1978).

Clusters	Clones
1 (high mean & low cv)	RRII 105, RRIM 600, PB235 *
2 (low mean & low cv)	RRIM 605, PB 5/51, PB 86, RRIC 105, GL 1
3 (high cv & low mean)	RRII 5, RRIC 52, GT 1, HARBEL 1
4 (high mean & high cv)	RRII 118, RRII 203, RRIM 703

* Most stable cluster

regression coefficient and the sum of squared deviations from regression. $S_i^{(3)}$ was found to have positive correlation with ecovalence and sum of squared deviations from regression. On the other hand, clustering method separates genotypes with general and specific adaptations. PB 235 has been rationalized as the integral part of the set of clones separated as stable by both the methods. Our earlier analysis with short term data also revealed supremacy of PB 235 over other clones (Vinod *et al.*, 1996). In yet another study with two years data, PB 235 along with PB 5/51, RRIM 703 and RRII 5 were found to be consistent over low and high yielding regimes (Priyadarshan *et al.*, 2000). Among the clones delineated as most stable as per clustering method, RRII 105 and RRIM 600 are already under commercial planting in Tripura. RRII 118, RRII 203 and RRIM 703 separated as with high mean and cv can also be considered as potential clones. The high cv exhibited could be in response to the fluctuations in environment. Since sensitive to environmental changes, they shall, perhaps ensure equilibrium in yield retrieval when planted as clone blends. These clones are seen to exhibit a gradual increment in yield from June onwards up to the begining of January and declines thereafter. Hence, the clustering method used here is seen to be an ideal procedure to delineate clones best suited for this non-traditional region.

Table 2. Ranking of 15 clones based on $S_i^{(3)}$ values (non-parametric - Huehn, 1990 a & b)

Clones	$S_i^{(3)}$	rank
RRII 5	2.491	8
RRII 105	2.273	6
RRII 118	5.619	13
RRII 203	4.000	12
RRIM 600	5.828	14
RRIM 605	3.447	11
RRIM 703	2.778	9
PB 5/51	1.069*	3
PB 86	2.181	5
PB 235	1.333*	4
RRIC 52	2.478	7
RRIC 105	3.070	10
GT 1	6.196	15
GL 1	0.060*	1
Harbel 1	0.353*	2

* stable clone

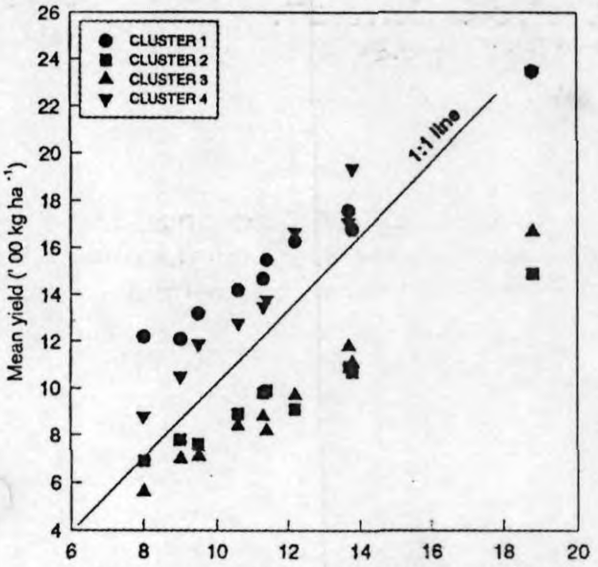
The projected yield was calculated for 15 clones under evaluation (Table 3). While PB 235 consistently gave maximum yield, in RRII 203 the yield steadily increased over the years. This consistency in yielding behaviour of PB 235 was rationalized in our earlier studies also (Priyadarshan *et al.*, 2000). Considerable increment was recorded in the case of RRII 118 from BO 2 panel onwards. The high yielding

Table 3. Projected yield of 15 clones over ten years.

Clone	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-2000
RRII 5	665	710	861	840	808	777	1113	1155	1806	1266
RRII 105	1011	1092	1305	1120	1211	1053	1400	1344	1956	1403
RRII 118	859	1001	1312	1291	1340	1326	1743	2033	1995	1615
RRII 203	875	1102	1347	1477	1414	1193	1711	2117	2800	2021
RRIM 600	1085	1207	1501	1592	1417	1232	1466	1494	2250	1940
RRIM 605	752	780	1211	1064	1032	780	1050	1169	1491	1379
RRIM 703	906	1053	1473	1074	1309	1053	1557	1666	2254	1496
PB 5/51	665	717	854	787	1011	840	955	1067	1494	964
PB 86	749	889	1092	1078	1092	976	1064	1211	1816	1231
PB 235	1554	1333	1844	1557	1785	1680	2030	2212	2845	1943
RRIC 52	521	689	833	815	1018	833	931	1256	1711	1153
RRIC 105	836	973	1116	955	1078	850	966	1326	1697	1266
GT1	577	707	833	1001	969	864	1123	1169	1816	1458
GI 1	497	556	710	570	675	374	525	553	948	601
HARBEL 1	472	707	766	689	742	357	717	878	1337	828

BO 2 Panel from October 1993; BI 1 Panel from September 1999; Tapping system: ½ S d/2 6d/7; No. of tapping days : 100 ; Trees / hectare : 350 ; Data from large-scale clone trial; Season: May to January.

Fig. 1. Depiction of environmental mean (kg ha^{-1}) against respective mean yields of clusters*



*Yield data of ten consecutive years 90-91 to 2000)

clones can be in the following descending order of hierarchy: PB 235, RRII 203, RRIM 600, RRIM 703 and RRII 105. Based on yield, the clones can be grouped into three categories: high, medium and low. Accordingly, PB 235, RRII 203, RRIM 600 and RRIM 703 have been selected for evaluation in the planters' field.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. N.M.Mathew, Director, Rubber Research Institute of India, for rendering facilities and encouragement.

REFERENCES

Ceccarelli, S., Grando, S. and Impiglia, A. 1998. *Euphytica,* **103:** 307-318.

Crossa, J. 1990. *Advances in Agronomy,* **44:** 55-85.

Eberhart, S.A. and Russell, W.A. 1966. *Crop Sci.,* **6:** 36-40.

Finlay, K.W. and Wilkinson, G.N. 1963. *Aust. J. Agri. Res.,* **14:** 724-754.

Francis, T.R. and Kannenberg, L.W. 1978. *Can. J. Plant Sci.,* **58:** 1029-1034.

Huehn, M. 1990a. *Euphytica,* **47:** 189-194.

Huehn, M. 1990b. *Euphytica,* **47:** 195-201

Linn, C.S. and Binns, M.R. 1991. *Theor. Appl. Genet.,* **82:** 505-509.

Priyadarshan, P.M., Vinod, K.K., Rajeswari, M.J., Pothen, J., Sowmyalatha, M.K.S., Sasikumar, S., Raj, S. and Sethuraj, M.R. 1998a. In: Developments in Plantation Crops Research (eds. N.M. Mathew and C. Kuruvilla Jacob) Allied Publ. New Delhi. pp. 63-68.

Priyadarshan, P.M., Sowmyalatha, M.K.S., Sasikumar, S., Varghese, Y.A. and Dey, S.K. 1998b. *Indian Journal of Natural Rubber Research,* **11:** 67-72.

Priyadarshan, P. M., Sasikumar, S., Varghese, Y.A. and Dey, S.K. 2000. *Indian Journal of Natural Rubber Research,* **13:** (in press).

Vinod, K.K., Rajeswari, J.M., Priyadarshan, P.M., Pothen, J., Chaudhuri, D., Krishnakumar, A.K., Sethuraj, M.R. and Potty, S.N. 1996. *Indian Journal of Natural Rubber Research,* **9:** 123-129.