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CLONAL SELECTION COMBINING YIELD AND STABILITY IN *HEVEA BRASILIENSIS* Muell. - arg.

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ABSTRACT

Selecting genotypes combining high yield and stability using appropriate statistical methods can bring out better cultivars. An attempt has been made in the above lines to isolate better *Hevea* clones based on their initial yielding performance at Rubber Research Institute of India, Agartala in North-East India which is a non-traditional rubber growing tract. Selection was made among fifteen oriental clones based on the parameters viz., mean dry rubber yield, stability variance, Rank-sum index (Index I), S^3_i and S^6_i. The data are based on average monthly dry rubber yield for three tapping seasons viz., 1990-91, 91-92 and 92-93. Index I is found to be a better indicator for selecting clones combining both yield and stability. S^3_i and S^6_i are found to tend more towards stability than yield. All the better yielders selected based on high yield alone viz., PB 235, RRIM 600, RRII 105, RRIM 703, RRII 203, RRII 118 and RRIC 105 are also found to be better performers based on Index I. However, the stability in yield over months is found decreasing when the yielding potential goes up. These clones can be utilised for setting up of composite clone gardens in the non-traditional regions.

INTRODUCTION

Increased interest in phenotypic stability in plant breeding programmes as well as in general crop production has been discussed with great emphasis in the recent years. Isolating genotypes combining higher yield and stability is necessary for utilising those cultivars which can perform exceptionally well under intensive and extensive crop production schemes (Westcott, 1986).

Several parametric and non-parametric statistics are available for estimating the genetic lissomess of the crops under wide range of predictable or unpredictable environments (Becker and Leon, 1988; Allard and Bradshaw, 1964). However, indices for choosing genotypes combining high yield and stability are quite scanty. Three non-parametric Statistics, namely S^3_i and S^6_i statistic (Huehn, 1979) a nd rank-sum index (Index I) (Kang, 1988) are described for simultaneous selection for yield and stability. Another statistic, S^3_i by Huehn (1990) also is available; however, this statistic and Huehn's (1979) S^6_i are directly related, that is S^6_i is the ratio between the sum of absolute rank deviation and the rank mean and S^3_i is the sum of the ratio of the Individual absolute rank deviation to the rank mean, over environments.

So far, these indices are employed in field crops only. Wricke and Weber (1986) have stressed the usefulness of such methods and opined that they could also be extended to open pollinated and vegetatively propagated species. Therefore, in the present study the above indices are utilised in an attempt to select high yielding and stable genotypes among fifteen *Hevea* clones from a clonal evaluation trial.

MATERIALS AND METHODS

The experimental material consisted of fifteen oriental clones of *Hevea* (Table I) planted in 1979 in a replicated evaluation trial at Taranagar farm of Rubber Research Institute of India at Agartala, Tripura. The research farm is located at 23,53' N and 91.15' E with an elevation of 16.6m from MSL. The trees were opened during last part of 1989 and then on, monthly average yield was recorded continuously till date, except during the annual rest periods. The data were recorded from dried cuplumps and expressed in dry weight basis. Invariably June to January were the tapping months and the data for three seasons viz., 1990-91, 1991-92 and 1992-93 were taken for analysis.

Table I. Fifteen oriental clones used in the evaluation.

Clone	Country of origioh
RRII 5	India
RRII 105	India
RRII 118	India
RRII 203	India
RRIM 600	Malaysia
RRIM 605	Malaysia
RRIM 705	Malaysia
PB 5/51	Malaysia
PB 86	Malaysia
PB 235	Malaysia
RRIC 52	Sri Lanka
RRIC 105	Sri Lanka
CT 1	Indonesia
GL 1	Indonesia
Harbel 1	Liberia

A combined analysis of variance was done and it was found that clone x month interaction under each year was significant. The average yield per clone for each year was calculated and stability variance (∂^2_i) (Shukla, 1972) of clones were computed. Ranks were assigned to yield and ∂^2_i independently and rank sum index (Index I) was derived as per Kan (1988). Huehn's (1979) statistics viz., S^3_i and S^6_i were computed. The expressions for the two statistics are as follows:

$$S^3_i = \frac{\sum_{j=1}^{N} (r_{ij} - \bar{r}_i)^2}{r_i}$$

$$S^6_i = \frac{\sum_{j=1}^{N} | r_{ij} - \bar{r}_i |^2}{r_i}$$

where, r_{ij} is the rank of i^{th} genotype in j^{th} month and r_i is the marginal rank mean of i^{th} genotype.

The selection of genotypes using the above parameters was done by assessing the interrelations via rank correlations among them as well as between the three years under study. All the analysis were done using a BASIC program generated for the purpose.

RESULTS AND DISCUSSION

Rank correlation coefficients between yield and the selection parameters viz., ∂^2_i, Index I, S^3_i and S^6_i for three years are given in Table II. Table III shows rank correlation of all these parameters between three years.

No significant correlation was observed between yield and ∂^2_i but index I was found positively correlated with yield and ∂^2_i. S^3_i and S^6_i were found negatively correlated with yield. The positive relationship of Index I with yield and ∂^2_i, offers Index I an opportunity to select for both yield and stability based on ∂^2_i. Such relationships between Index I, S^3_i and S^6_i to give equal opportunity to weigh upon yield or yield stability has been described by Leon (1986), Becker and Leon (1988) and Kang (1988).

Table II. Rank correlation between different parameters for three years.

	Year	σ^2_i	Index 1	S^3_i	S^6_i
	90-91	-0.111	0.618*	-0.837**	-0.661**
Yield	91-92	- 0.325	0.579*	-0.832**	-0.800**
	92-93	-0.232	0.658**	-0.861**	-0.657**
	Pooled	- 0.179	0.664**	-0.818**	-0.672**
	90-91		0.671**	-0.111	0.094
σ^2_i	91-92		0.565*	0.604*	0.582*
	92-93		0.551*	0.604*	0.418
	Pooled		0.586*	0.360	0.346
	90-91			-0.536*	-0.532*
Index 1	91-92			-0.160	-0.213
	92-93			-0.144	--0.406
	Pooled			-0.263	-0.396
	90-91				0.896**
S^3_i	91-92				0.971**
	92-93				0.843**
	Pooled				0.949**

* Significant at 5% confidence limit.
** Significant at 1% confidence limit.

Table III. Rank correlation of selection parameters between three yielding years

		91-92	92-93
	Yield	0.939**	0.954**
90-91	σ^2_i	0.507**	0.836**
	Index 1	0.650*	0.897**
	S^3_i	0.811*	0.636*
	S^6_i	0.874**	0.729**
	Yield		0.939**
91-92	σ^2_i		0.604*
	Index 1		0.684**
	S^3_i		0.732**
	S^6_i		0.469*

* Significant at 5% confidence limit.
** Significant at 1% confidence limit.

Table IV. Simultaneous selection parameters for yield and stability for fifteen clones.

Clone	Dry rubber yield (g tree^{-1} tapping^{-1})	Stability variance	Yield rank	Index 1	s^{3}_{1}	s^{6}_{1}
PB 235	45.81	127.70	1 (S)	16 (S)	16.00	48.00
RRIM 600	36.85	27.38	2 (S)	16 (S)	6.68	24.32
RRII 105	33.61	41.49	3 (S)	15 (S)	5.00	24.00
RRIM 703	33.16	5.97	4 (S)	6 (S)	1.07 (S)	0.93 (S)
RRII 203	32.64	11.78	5 (S)	11 (S)	14.76	41.21
RRII 118	29.37	6.73	6 (S)	10 (S)	2.15 (S)	4.85 (S)
RRRIC 105	28.57	6.45	7 (S)	10 (S)	2.15 (S)	12.31
RRIM 605	27.02	29.48	8	18	5.66	13.71
P 86	26.68	15.97	9	16 (S)	3.50	12.00
RRII 5	22.31	24.67	10	19	7.37	16.00
PB 5/51	22.14	0.10	11	12 (S)	2.00 (S)	8.00 (S)
GT 1	20.59	16.44	12	20	1.00 (S)	5.33 (S)
RRIC 52	19.87	31.56	13	24	0.94 (S)	5.55 (S)
Harbel 1	19.05	9.37	14	19	1.04 (S)	5.93 (S)
GL 1	17.00	54.09	15	28	1.94 (S)	7.33 (S)

The rank correlation between years for all the different parameters showed significant positive relationships indicating that the ranking of clones within the years was statistically identical. Hence pooled data was utilized to obtain the simultaneous selection parameter for both yield and stability.

Mean clone yield, ∂^2_i, Index I, S^3_i and S^6_i using the pooled data are given in Table IV. Clones with lowest values of all the parameters except in mean yield are selected as they indicate for better yield and/or stability (Shukla, 1972; Huehn, 1979; Kang, 1988). If 50% of the best clones are selected under each parameter, based on yield rank, first seven clones to be selected as per yield ranks would be PB 235, RRIM 600, RRII 105, RRIM 703, RRII 203, RRII 118 and RRIC 105. When the selection is made on the basis of Index I all the clones selected under yield will be selected in addition to two more clones, PB 5/51 and PB 86. Here the selection was extended to nine genotypes because three clones viz., PB 235, RRIM 600 and PB 86 share the same index value of 16.

Selection based on S^3_i and S^6_i tends more towards the stability than yield as evident from their strong negative association with yield and strong positive correlation among themselves. However, their association with S^6_i is not a consistant factor as S^3_i shows positive association during 91-92 and 92-93 and S^6_i during 91-92 only (Table II). This may be due to the fact that 6^2_i is based on the real values and S^3_i and S^6_i are based on ranks. The clones selected under S^3_i including GT 1, RRIC 52, H1, GI 1, PB 5/51, RRII 118, RRIM 703 and RRIC 105 out of which the last three clones only are commonly found among the clones selected based on yield and the last four clones are common among the clones selected based on Index 1. However, when selection was based on S^6_i all the clones selected under S^3_i except RRIC 105 were selected.

Since yield and stability are not correlated positively it is evident that higher yielding clones when the peak yielding period approaches during November. However, RRII 118 and RRIM 703 followed by RRIC 52 have shown relatively less fluctuation than other high yielders and hence are selected by almost all the selection indices.

The above study indicated that Index I was better than S^3_i and S^6_i for selecting clones simultaneously for yield and stability. This has already been described by Kang and Pham (1991) in maize trials. They proposed that Index I was an intermediate estimate between S^3_i and S^6_i and assigns equal weight to yield and stability and would be a better index for selecting for both yield and stability.

The present study has selected nine clones on the basis of index I, in the order RRIM 703, RRII 118, RRIC 105, RRII 203, PB 5/51, RRII 105, PB 235, RRIM 600 and PB 86. Out of these PB 5/51 and PB 86 are not selected as high yielders. It can be concluded that in the initial stages of yielding, by giving equal weights to yield and stability all the top yielders selected are better performers, nevertheless the stability decreases when the yield level goes up.

Thus, it should be emphasised that these selected clones can be utilised in composite planting programmes and also in selecting clones for setting up of multiclonal gardens, where yield and stability share the priority especially in the non- traditional rubber growing tracts.

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