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CLONE X ENVIRONMENT INTERACTION DURING EARLY GROWTH PHASE OF *HEVEA BRASILIENSIS* I. CLONAL STABILITY ON GIRTH

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A study was carried out to determine the clone X environment interaction during the early growth phase of 15 *Hevea* clones at Taranagar Farm of the Regional Research Station of the Rubber Research Institute of India. The results showed that the rate of increment in girth significantly decreased with increasing age irrespective of seasons (winter/summer). However, there was wide differences between the girth increment during summer and winter months. GE interaction parameters like ecovalence and stability variance showed that clones studied have differential adaptability. The data suggest that clones RRIM 600, PB 86 and GT 1 are widely adapted showing more flexibility and those like RRII 105 are specifically adapted with less flexibility. The results indicate that selection for phenotypic stability can lead to isolation of stress resistant genotypes.

Key words:- Hevea brasiliensis, Phenotypic stability, Ecovalence, Stability variance, Adaptability, Non-traditional area.

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INTRODUCTION

Genotypes of almost all cultivated species often exhibit differential reaction to different macroenvironments like agroclimatic zones, management levels, etc (Becker and Leon, 1988). *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Muell. Arg., the natural rubber yielding tropical tree, is no exception to this. Consequently breeding for wider adaptability or phenotypic stability over environments becomes complex because the genotype X environment (GE) interaction makes it difficult to predict how a genotype selected under one environment will behave in another (Ceccarelli, 1989).

Hevea, though genetically adapted to tropical environment, has proved to thrive in subtropical agroclimatic zones such as in North-East India and China. Varied performance of *Hevea* genotypes has also been reported in North-East India where two distinct seasons, summer and winter, prevail (Rubber Research Institute of India, 1989). Information on GE interaction will prove to be of vital importance for successful introduction of this crop, particularly in non-traditional regions like North-East India where the crop growth confronts with stress situations. Studying the GE interaction of a particular genotype (Wricke, 1962 and Shukla, 1972) helps in predicting the genotypic flexibility for improvement of crop production across macroenvironments. The planting recommendation data so far available in rubber tell us nothing about the GE inter-action and indeed really no good data exist. Simmonds (1989). However, earlier reports from Sri Lanka (Jayasekera *et al.*, 1977; Jayasekera, 1983) indicate detailed studies on GE interaction in *Hevea*.

MATERIALS AND METHODS

Materials for the present study comprised of 15 clones in a clonal evaluation trial planted during 1979 at Taranagar Farm, Agartala (91° 15' E., 23° 53' N., elevation 16.6 m MSL) of the Rubber Research Institute of India. Fifteen trees were selected per clone for the study from the replicated trial. The girth at 125 cm height was recorded for growth in winter and summer during April/May and October/November respectively every year, from 1981 October/November onwards. The increments in girth were expressed as percentage over the girth at the beginning of the season.

The girth data until October 1989 were analysed statistically and the means were compared using Duncan's Multiple Range Test. The GE interaction parameters like ecovalence (Wricke, 1962) and stability variance (Shukla, 1972) were estimated for each clone for comparison of their genotypic flexibility.

RESULTS AND DISCUSSION

The increment in girth during early growth stages was found to be highly significant in both winter as well as summer seasons with the highest values at 13.71 per cent and 41.42 per cent in winter and summer 1982, respectively (Table 1). The increment during winter was considerably lower than that during summer. Besides, the increment in girth significantly decreased with increase in age irrespective of the seasons throughout the period of study except during the winter period of 1985–87 when the reduction was not significant. This may be due to severe shock suffered by the trees consequent to a hail-storm during 1986 April.

Table 1. **Mean seasonal girth increment for the 15 clones**

Year	Girth increment (%)			
	Winter		Summer	
1982	13.71 (21.61)	a	41.42 (40.05)	a
1983	9.71 (18.04)	b	38.12 (38.11)	b
1984	6.60 (14.80)	c	27.45 (31.57)	c
1985	5.71 (13.83)	cd	17.30 (24.55)	d
1986	5.06 (12.98)	de	9.05 (17.44)	e
1987	4.64 (12.39)	ef	7.59 (15.84)	f
1988	3.20 (10.24)	g	5.23 (13.19)	g
1989	1.72 (7.48)	h	3.81 (11.20)	h

Figures in parentheses are arcsine transformed values; means followed by the same letter in a column are not significantly different by DMRT (P = 0.05).

The mean girth increment of individual clones during the summer months was not significant. However, the values relating to the winter season could be classified into three groups. The clones RRIM 600, RRIM

703 and PB 5/51 were found to be common to all the three groups. RRIC 52 nevertheless performed better during winter in the girth group and Harbel 1 was rated as a poor performer in the last group (Table 2).

Table 2. **Mean winter and summer girth increment (%)**

Clones	Winter		Summer	
RRIC 52	7.11 (15.01)	a	20.46 (25.55)	a
PB 86	6.94 (14.80)	ab	27.89 (23.91)	a
RRII 105	7.07 (14.65)	ab	18.33 (23.58)	a
PB 235	6.50 (14.34)	ab	18.73 (23.99)	a
RRII 118	6.71 (14.27)	ab	18.66 (23.89)	a
GT 1	6.46 (14.13)	ab	17.70 (23.24)	a
RRII 5	6.62 (14.08)	ab	19.10 (24.25)	a
RRIC 105	6.54 (14.06)	ab	20.00 (24.80)	a
RRIM 600	6.30 (13.94)	abc	18.64 (24.03)	a
RRIM 703	6.06 (13.69)	abc	17.24 (22.64)	a
PB 5/51	6.18 (13.50)	abc	18.94 (24.07)	a
RRII 203	5.58 (13.34)	bc	19.42 (24.59)	a
RRIM 605	5.81 (13.31)	bc	19.58 (24.29)	a
Gl 1	5.66 (13.29)	bc	18.69 (24.18)	a
Harbel 1	4.93 (12.44)	c	17.72 (23.08)	a

Figures in parentheses represent transformed values; means followed by the same letter in a column are not significantly different according to DMRT (P = 0.05).

The phenotypic stability parameters like ecovalence and stability variance gave a clearer picture of the GE interaction during early growth of *Hevea*. This is very important because the differential responses due to the GE interaction makes the location based varietal recommendations more difficult (Gorman *et al.*, 1989) and its contributing effects can hamper the varietal selection process (Comstock and Moll, 1963). Becker and Leon (1988) stated that a better adapted genotype would be the one which shows lower values of ecovalence and stability variance and high mean value of the character in question. In the present situation RRIM 600 showed lowest values for both the parameters (Wi = 1.12 and σ_i^2= 0.06) and also showed a non-significant position among the better performers during winter followed by PB 86 (Wi = 3.87 and σ_i^2 = 0.51) and GT 1 (Wi = 5.94 and σ_i^2 = 0.86). However, during the summer months RRII 105 (Wi = 6.53 and σ_i^2 = 0.72) and Harbel 1 (Wi = 6.85 and σ_i^2 = 0.78) were found to be more stable (Table 3).

Table 3. **Stability parameters of clones over winter and summer**

Clone	Winter		Summer	
	Ecovalence (Wi)	Stability (σ_i^2)	Ecovalence (Wi)	Stability (σ_i^2)
RRIC 52	8.36	1.25	22.61	3.38
PB 86	3.87	0.51	74.73	11.97
RRII 105	13.83	2.16	6.53	0.72
PB 235	7.26	1.07	71.79	11.48
RRII 118	11.22	1.73	49.29	7.77
GT 1	5.94	0.86	11.81	1.60
RRII 5	12.50	1.94	24.68	3.72
RRIC 105	16.94	2.67	22.45	3.35
RRIM 600	1.12	0.06	18.92	2.77
RRIM 703	9.82	1.50	14.60	2.06
PB 5/51	21.83	3.48	11.65	1.57
RRII 203	10.76	1.65	35.07	5.43
RRIM 605	6.44	0.94	60.16	9.57
Gl 1	15.02	2.35	16.55	2.38
Harbel 1	12.13	1.88	6.85	0.78

The results indicate that RRIM 600, PB 86 and GT 1 (clones with stability variance less than one) could be widely adapted genotypes because they exhibited stable performance in winter as well as competent girth increment during summer. The clones like RRII 105 which show high performance with partial adaptability over seasons can be specifically adapted. This grouping however is limited to the environment to which the clones were exposed. The clones studied could be ranked in the order: RRIM 600, PB 86, GT 1, RRIM 605, PB 235, RRIC 52, RRIM 603, RRII 203, RRII 118, Harbel 1, RRII 5, RRII 105, Gl 1, RRIC 105 and PB 5/51. It can be interpreted that differences occur due to differential interaction to environmental stresses like drought, cold, etc. The selection for improved phenotypic stability can lead to the isolation of stress resistant clones.

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