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PERFORMANCE ANALYSIS FOR WINTERING PATTERN IN *HEVEA BRASILIENSIS* CLONES

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A study was undertaken to group rubber (*Hevea brasiliensis*) clones based on their wintering behaviour in Tripura, one of the rubber growing areas of North East India. Fifteen clones from a clone evaluation trial were scored for the wintering pattern at weekly intervals for six weeks from December to February during 1988-89, 1989-90 and 1991-92 period. Wintering pattern of clones was uniform for all the years under study. Mean weekly scores were used for clustering process. Three distinct clusters of early, intermediate and late wintering clones were obtained viz., (i) RRII 105 and RRIC 105, (ii) RRIM 600, PB 86, GT 1, RRIC 52 and PB 235 and (iii) RRII 118, RRIM 605, Gl 1, Harbel 1, RRII 5, PB 5/51 and RRIM 703. The remaining clone, RRII 203, was found to fall in between the second and the third clusters. The results can be used in characterising clones as well as selecting clones for establishing polyclonal breeding gardens.

Key words : *Hevea brasiliensis*, Wintering, Cluster analysis , Tripura

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INTRODUCTION

The rubber tree, *Hevea brasiliensis* exhibits regular annual leaf shedding called 'wintering'. Wintering pattern in different rubber clones varies from complete defoliation followed by refoliation to simultaneous shedding and flushing (Webster and Paardekooper, 1989). Wintering in traditional regions is reported to start during December and continue upto February. The clonal specificity on wintering behaviour in these regions also is well established (George *et al.*, 1980; Webster and Paardekooper, 1989). The rubber growing areas of North East India experience severe winter. Clonal characterisation based on wintering pattern of different clones in the non-traditional region of India has not yet been attempted. The present study was aimed at analysing the wintering behaviour of different clones in Tripura and to group them into different categories.

MATERIALS AND METHODS

Fifteen oriental clones *viz.*, RRIM 600, RRIM 605, RRIM 703, RRII 5, RRII 105, RRII 118, RRII 203, RRIC 52, RRIC 105, PB 5/51, PB 86, PB 235, GT 1, Gl 1 and Harbel 1 planted during 1979, in a clone evaluation trial at the Rubber Research Institute of India's regional research farm at Taranagar, Agartala,Tripura (91° 15'E; 23° 25'N; 30 m MSL) were used for the study. Twenty trees per clone were selected and observed individually for the entire leaf fall period at weekly intervals from December to

February and their wintering pattern scored visually using the scale presented in Table 1. Observation was initiated in 1987-88 season and concluded during 1991-92. In general, the leaf shedding process extended for six effective weeks every year. The weighted average score of individual clone was computed for every week. Three years data *i.e.*, 1988-89, 1989-90 and 1991-92 were used for ranking clones based on the weekly progress of wintering, individually for each year. Rank correlation was computed to study the homogeneity in wintering behaviour in different years. Analysis of variance was performed using the average score data. The average data was also used to compute the dissimilarity values between clones using the formula,

$$d_{ii'}=\sqrt{\sum_{j=1}^{n}(x_{ij}-x_{i'j})^2}$$

where, $d_{ii'}$ is the distance between clones i and i' (i=1 to m) and x_i and $x_{i'}$ are the values of clones i and i' for the corresponding week, j (j=1 to n).

The dissimilarity matrix was used to cluster the clones using Sneath and Sokel's (1973) unweighted pair group method using arithmetic averages (UPGMA). A dendrogram was constructed using the computed values.

RESULTS AND DISCUSSION

The close association of wintering pattern of clones between the years over the weeks showed that wintering is not a random phenomenon and is less influenced by the years (Table 2). The analysis of variance showed significant variation in wintering pattern contributed by clones, weeks and their interaction (Table 3). Also, the highly significant rank correlation coefficients between weeks of individual years, confirmed distinct variation in wintering pattern over weeks as wintering process advanced. This was evident from close correlation of adjacent weeks except for the weeks 1 and 2, and fading relations as the weeks advanced (Table 4). The weak correlation of first and second week can be

Table 1. **Score chart for visual scoring of wintering pattern**

Score	Wintering (%)	Description
0	0-5	No leafless branches, branches bear complete green leaves; yellow leaves permitted only upto 5% of the total canopy
2	6-25	5% leafless branches; yellow or orange leaves permitted only upto 25% of the total canopy; 100% leaves showing general yellowing; green leaves should not be less than 75%
4	26-50	25% leafless branches, yellow, orange, red or brown leaves only upto 50% of the total canopy; green leaves should not be less than 50%
6	51-75	Leafless branches, yellow, orange, red or brown leaves permitted upto 75% of the canopy; green or yellow leaves should not be less than 25%
8	76-95	Green or yellow green leaves should not be more than 5% of the total canopy; remaining part of the canopy should mostly be of barren branches and of few orange, red or brown leaves falling continuously
10	96-100	No green leaves at all; tree must be completely leafless or a few branches may have falling red or brown leaves; occasional new flushes are permitted

Table 2. **Spearman's rank correlation coefficients for wintering pattern over weeks between years**

	Yr 1 & Yr 2	Yr 1 & Yr 3	Yr. 2 & Yr 3
Week 1	0.917**	0.912**	0.846**
Week 2	0.735**	0.792**	0.880**
Week 3	0.626*	0.743**	0.581*
Week 4	0.856**	0.718**	0.689**
Week 5	0.782**	0.704**	0.591*
Week 6	0.632*	0.796**	0.809**

* Significant at 5% level

** Significant at 1% level

attributed to variations in clonal performance, as progress of wintering in certain clones was very slow in the first week while in certain others it was rapid. The uniform correlation in all the three years indicated once again that the years had no effect on wintering pattern.

Clonal specificity for wintering behaviour is apparent and the extent of wintering influences the period of yield depression. Clones which shed and replace their canopy fast show little fluctuation in yield pattern. Fast wintering clones escape from the incidence of leaf diseases while the slow wintering ones will be having young leaves for considerably longer period and expose them to inoculum build up (Peries, 1979; Webster and Paardekooper, 1989).

As the effect of years was not prominent, the average weekly data were used for grouping the clones based on their wintering behviour. The dendrogram constructed using UPGMA is given in Figure 1. The dendrogram revealed three distinct clusters, cluster I including clones RRII 105 and RRIC 105, cluster II with RRIM 600, PB 86, GT 1, RRIC 52 and PB 235 and cluster III of RRII 118, RRIM 605, Gl 1, Harbel 1, RRII 5, PB 5/51 and RRIM 703. RRII 203 was found to fall in between clusters II and III. The individual clusters had close relatives grouped together like, RRIM 600 (Tjir 1 x PB 86) and PB 86 falling in cluster II and RRII 203 (PB 86 x Mil 3/2) falling in between clusters II and III, indicating the possibility of genetic determination of wintering behaviour. However, there are deviations also which may be due to variations in parental genetic constitution and their segregating nature.

Table 3. **Analysis of variance of wintering pattern**

Source	df	Mean squares	F-value
Years	2	1.558	
Clone	14	4.786	35.27**
Week	5	361.788	2665.92**
Clone x Week	70	0.816	6.02**
Residual Error	178	0.136	

** Significant at 0.1% level

The clones in cluster I are fast wintering and start to shed leaves earlier than the

Table 4. **Spearman's rank correlation values between weeks for three years**

	Week 2	Week 3	Week 4	Week 5	Week 6
Week 1					
Yr 1	0.053	-0.071	0.227	-0.102	-0.468
Yr 2	0.432	0.191	0.254	0.183	-0.071
Yr 3	0.422	0.398	-0.045	-0.142	-0.188
Week 2					
Yr 1		0.881**	0.865**	0.612*	0.376
Yr 2		0.603*	0.406	0.308	0.121
Yr 3		0.784**	0.447	0.188	0.059
Week 3					
Yr 1			0.798**	0.598**	0.363
Yr 2			0.479	0.126	-0.088
Yr 3			0.596**	0.338	0.146
Week 4					
Yr 1				0.738**	0.396
Yr 2				0.818**	0.571*
Yr 3				0.676**	0.622**
Week 5					
Yr 1					0.757**
Yr 2					0.798**
Yr 3					0.754**

* Significant at 5% level

** Significant at 1% level

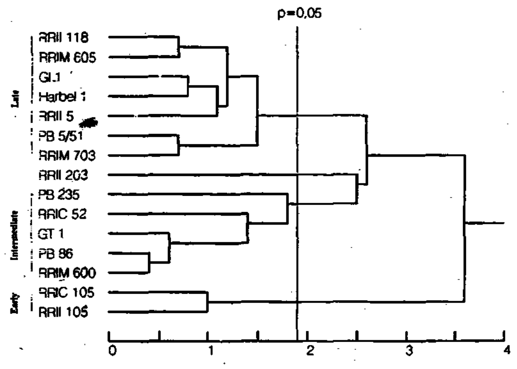

Fig. 1. Dendrogram of 15 clones by UPGMA

other clones and begin to reflush immediately after completion of leaf shedding. The third cluster has slow wintering clones, which usually start late and finish late and remain leafless for a short period before reflushing. Clones which fall under second cluster are intermediate in their wintering behaviour.

The distinct grouping of clones can be used for clonal characterisation as well as for using them appropriately in breeding gardens. Moreover, appropriate disease control strategies can be evolved based on the pattern of wintering.

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