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EVALUATION OF *HEVEA* GERMPLASM : VARIATION IN BARK STRUCTURE OF WILD BRAZILIAN GERMPLASM

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Morphological and anatomical observations were carried out on 100 randomly selected wild *H. brasiliensis* genotypes aged 24 months, belonging to the 1981 IRRDB Brazilian germplasm collection, established at the Rubber Research Institute of India. RRII 105 and GT 1 were used as checks. The characters studied were girth, bark thickness, number of latex vessel rows in the stone cell occupied zone, total number of latex vessel rows, density of latex vessels, diameter of latex vessels, thickness of latex vessel free zone, thickness of stone cell free zone, average distance between latex vessel rows, total cross sectional area of laticifers and test tap yield. For many of the characters the wild genotypes were inferior to the controls. There was however a wide range of variability for the characters studied. Among the wild genotypes Matto Grosso accessions showed superiority for most characters, with MT 999 being the most desirable. The high variability for vital anatomical characters related to yield can be used in crop improvement programmes.

Key words : *Hevea brasiliensis*, Brazilian germplasm, Bark anatomy.

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INTRODUCTION

The rubber plantation in the eastern hemisphere, raised from a few seeds collected and introduced by Sir Henry Wickham in 1876, have only a very narrow genetic base (Schultes, 1977). To achieve high economic returns, the crop was subjected to intensive selection pressure which led to a further reduction in the gene pool (George, 1989). To broaden the genetic base an exploration expedition was launched by the International Rubber Research and Development Board (IRRDB) in 1981 to three states (Acre, Rondonia and Matto Grosso) of Brazil. The present study was made on a sample of this collection being conserved at the Rubber Research Institute of India, with the objective of obtaining an idea on the variability in the bark anatomical traits. Information on these lines is very meagre and the data collected from the juvenile growth phase of these wild clones will be useful in identification of potential parents with superior traits, for future crop improvement programmes.

MATERIALS AND METHODS

From the wild Brazilian germplasm of *H. brasiliensis* planted in 1990 at the Central Experiment Station of the Rubber Research Institute of India, 100 genotypes were chosen for the investigations. The

three provinances Acre(AC), Rondonia(RO) and Matto Grosso(MT), were represented by 41, 30 and 29 genotypes respectively. The age of the plants was 24 months. Out of the ten plants per genotype planted in a row, at 1 x 1 m spacing, six plants were chosen randomly per genotype for the observations. GT 1 and RRII 105 were used as checks. Bark samples were collected at a height of 40 cm from the bud union. Transverse and radial and tangential longitudinal sections of 40 to 80 µm thickness were taken with a base sledge microtome and stained with sudan III for microscopic observations.

For convenience of observations and to understand the relative configurations of cells and tissues in cross (CS), tangential longitudinal (TLS) and radial longitudinal (RLS) sections of the bark, the total sectioned area of bark was divided into three zones, (i) region between cambium and inner most row of latex vessels (latex vessel free zone - LVFZ), (ii) region from cambium to the stone cell zone (stone cell free zone - SCFZ) and (iii) stone cell occupied zone (SCOZ). Observations were taken on number of latex vessel rows in the stone cell free zone (LVR in SCFZ), number of latex vessel rows in the stone cell occupied zone (LVR in SCOZ), total number of latex vessel rows (TLVR), density of latex vessel per 2 mm circumference of the plant (DLV), diameter (µm) of latex vessels, thickness (mm) of latex vessel free zone, thickness (mm) of stone cell free zone, average distance (mm) between latex vessel rows (distance LVR) and total cross sectional area (mm^2) of latex vessels (Gomez *et al.*, 1972). The observations were recorded following standard microtechniques on individual plant basis and the mean values calculated. Girth (cm) and bark thickness (mm) at 40 cm height were also measured. The plants were test tapped on 1/2S d/2 system for ten days and the dry weight of rubber from 6th to 10th day (5 days) was determined.

RESULTS AND DISCUSSION

Mean values of the characters studied in the wild population along with those of the check clones, are given in Table 1. A wide range of variation was noted among the wild genotypes for all the characters studied. For all the traits except yield, higher values than that of the control were observed in the individual wild genotypes. The genotype MT 999 was found to have the highest values for the characters TLVR (7.00), DLV (23.83), diameter of latex vessels (27.99 µm) and cross sectional area of laticifers (8.82 mm^2) and the lowest value for the average distance between latex vessel rows (0.256 mm). The maximum yield on test tappings was noted for the genotype MT 1020 (2.98 g) compared to the mean yield of 6.53 and 6.25 g respectively for RRII 105 and GT 1.

The population means for all the characters studied were found to be lower than the corresponding mean values of the controls except for the trait LVFZ. The population means for DLV and diameter were comparable to those of the checks.

Provenance wise grouping of the population (Table 1) showed that the average girth of the AC genotypes was higher than that of genotypes from the other two provenances. For bark thickness, MT genotypes were superior. However, in both the cases the values of the controls were higher compared to those of the wild genotypes.

Higher mean values for TLVR, DLV, diameter, cross-sectional area of laticifers and yield were observed in the MT genotypes. The average values of the MT genotypes for all these characters except yield was comparable with, and even higher than that of the controls. The mean thickness of the stone cell free zone was maximum in MT genotypes. The control clone RRII 105 showed the highest value (1.22 mm) for this character whereas GT 1 and

Table 1. **Population characters**

Character	Population range		Population*	Provenance mean*			Controls	
	Minimum	Maximum	mean	Acre	Rondonia	Matto Grosso	GT 1	RRII 105
Girth (cm)	12.42 (RO 343)	18.25 (AC 655)	14.86(8.16)	15.42(8.51)	14.11(7.76)	14.89(7.04)	17.33	16.17
Bark thickness (mm)	1.83 (AC 688)	3.08 (AC 685)	2.37(10.71)	2.31(10.30)	2.25(8.10)	2.58(8.47)	2.92	2.92
LVR in SCFZ	1.00 (AC 624AC 714)	3.50 (MT 1016)	2.20(22.82)	2.70(25.13)	2.20(19.41)	2.39(21.86)	2.83	2.33
LVR in SCOZ	1.00 (24 genotypes)	3.00 (MT 999)	1.41(29.95)	1.39(27.49)	1.17(21.05)	1.70(29.04)	1.83	1.67
TLVR	2.00 (AC 714)	7.00 (MT 999)	3.62(20.82)	3.48(20.79)	3.38(14.43)	4.08(21.90)	4.66	4.00
DLV	10.17 (RO 319)	23.83 (MT 999)	19.15(12.83)	19.36(13.66)	17.99(13.34)	20.09(10.29)	18.33	19.17
Diameter (µm)	14.29 (MT 1030)	27.99 (MT 999)	22.01(12.20)	22.74(8.39)	19.46(7.64)	23.74(13.93)	21.98	22.16
Thickness of LVFZ(mm)	0.255 (MT 1000)	0.55 (AC 630)	0.37(18.48)	0.34(19.07)	0.39(15.90)	0.38(15.16)	0.33	0.29
Distance of LVR (mm)	0.256 (MT 999)	0.79 (AC 622)	0.43(27.27)	0.46(27.71)	0.39(23.81)	0.42(28.46)	0.47	0.47
Thickness of SCFZ(mm)	0.706 (AC 654)	1.34 (AC 685)	1.01(11.14)	0.97(14.95)	1.00(14.39)	1.07(7.77)	1.06	1.22
Laticifer CS area(mm^2)	0.63 (MT 1030)	8.82 (MT 999)	2.17(48.82)	2.05(33.35)	1.61(30.39)	2.90(49.89)	2.82	2.42
Test tap yield (g)	0.051 (RO 319)	2.98 (MT 1020)	0.57(89.10)	0.38(67.84)	0.37(82.14)	1.06(62.08)	6.25	6.53

* Figures in parentheses are CV values

MT genotypes had almost similar mean values.

The results indicated that among the wild population the genotypes from Matto Grosso showed overall better performance compared to those from Acre and Rondonia for most of the characters studied and that the Rondonian genotypes were found to have an average performance falling between that of Acre and Matto Grosso genotypes. This is in agreement with the reports of Demange *et al.* (1990) and Abraham *et al.* (1992).

In the population, the test tap yield showed the maximum variation (89.1%) followed by the laticifer CS area, while all the other characters showed medium to low variability. Provenance wise comparison of the characters showed that RO genotypes had the highest coefficient of variation for test tap yield. Matto Grosso genotypes had the highest variability for the characters laticifer CS area, diameter of latex vessels and TLVR in SCOZ, while maximum variability for LVR in SCFZ and thickness of LVFZ were shown by AC genotypes. Variability values were found to be comparable in MT and AC genotypes for the character TLVR. For the characters girth and bark thickness comparable levels of variability were found in the genotypes from the three states.

Bark thickness and percentage thickness of various zones of the bark from cambium outwards is presented in Table 2. Of the genotypes from the three provenances, the percentage thickness of stone cell free bark zone was found to be the highest in AC genotypes while RO and MT

Table 2. **Thickness of zones in the bark**

Genotype/ population	Bark thickness (mm)	Stone cell free zone		Stone cell occupied zone		LV free zone	
		(mm)	(%)	(mm)	(%)	(mm)	(%)
Acre	2.31	0.632	27.36	1.337	57.88	0.341	14.76
Rondonia	2.25	0.607	26.98	1.252	55.64	0.391	17.38
Matto Grosso	2.58	0.690	26.74	1.507	58.42	0.383	14.84
GT 1	2.92	0.726	24.86	1.861	63.74	0.333	11.40
RRII 105	2.92	0.929	31.82	1.697	58.11	0.294	10.07

genotypes were comparable. All the three had values lower than those of RRII 105 and higher than those of GT 1. The percentage thickness of bark zone occupied by stone cells was comparatively lower in RO and higher in MT genotypes. However, the maximum percentage of bark zone occupied by stone cells was observed in GT 1 (63.74%). The percentage thickness of bark zone contiguous with cambium devoid of latex vessels was found to be higher in the wild genotypes than in the controls. Among the wild genotypes this percentage was comparatively more in RO than in AC and MT genotypes. Eventhough the percentage thickness of the bark zone without stone cells was comparable for the genotypes from Rondonia and Matto Grosso, the higher test tap yield of MT genotypes is indicative of their genetic superiority.

In general, the present study reveals the wide variability existing in the wild population for many of the bark anatomical characters. The genotypes belonging to Matto grosso were found to have better anatomical traits than those belonging to Acre and Rondonia. The lower yield inspite of superior anatomical traits of Matto Grosso genotypes when compared to controls might be due to the influence of genetic and physiological factors which requires further investigation. The genotype MT 999 was superior for total number of latex vessel rows and density, diameter and cross sectional area of laticifers. The high variability found for yield related anatomical traits can be used for crop improvement.

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