

EVALUATION OF *HEVEA* GERMPLASM VIII. VARIABILITY IN CERTAIN JUVENILE CHARACTERS OF WILD *HEVEA* GERMPLASM

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(Received 2 April 1996, revised accepted 18 November 1999)

SUMMARY

A preliminary study was conducted to identify the nature and extent of variability in the wild populations of *Hevea brasiliensis* introduced from Brazil. Seventy-five wild *Hevea* genotypes along with control RRII=105 were chosen for the study at the age of 4 years. The wild genotypes belonging to the 3 provenances of Acre, Rondonia and Matto Grosso of Brazil, planted during 1989 in the Rubber Research Institute of India. Observations on total height of the plant, first branching height, girth, bark thickness, single leaf area, average test tap yield and number of latex vessel rows were recorded. Mean values, estimates of variability like phenotypic and genotypic coefficient of variation and certain genetic parameters were ascertained. A comparison of the 3 provenances reveals that Matto Grosso genotypes performed well for most of the characters. A judicious selection of these promising diverse materials could be used in crop improvement programme.

Key Words : *Hevea*, germplasm, variability, provenances.

INTRODUCTION

The plant genetic resources can be grouped into cultivated and wild species. Genetic variability of cultivated plants is not randomly distributed throughout the world. In rubber, the Wickham collection of 1876 is the base material for the present day rubber plantations of Far East, which represents a very small genepool, since, it was collected from a limited area (Schultes 1977). Over the years, directional selection for yield alone from the Wickham genetic materials contributed to the several fold increase in yield in the past few decades. Consequently, the scope for further improvement in yield is limited. Moreover, there is a decrease in genetic diversity for secondary traits as well.

All these factors have necessitated the exploration of the Amazon Forests, the primary centre of origin of the crop for wild germplasm. This resulted in the collection and conservation of wild *Hevea* germplasm available in the 3 provenances of Brazil, viz., Acre (AC), Rondonia (RO) and Matto Grosso (MT). This expedition was organised by the International Rubber Research and Development Board in the year 1981, and a share of this has been received by the Rubber Research Institute of India. These materials are being conserved for characterisation, cataloguing, evaluation and use. In the present study an attempt has been made to identify the nature and extent of variability in certain morphological and anatomical traits present in these wild populations which would ultimately help to identify certain potential parents for future breeding and crop improvement programmes.

* Presented at VI All India Conference on Cytology and Genetics held from March 8-10, 1996 at Rohtak.

MATERIALS AND METHODS

Seventy five genotypes of wild *Hevea* germplasm were randomly selected from the 1989 source bush nursery at the age of 4 years. These genotype were planted at a spacing 1 x 1 and 5 trees from each genotype were selected for the present study. RR11 105 was chosen as control. The characters studied were i) Height of the plant (m) from the bud union, ii) first branching height (m) from the bud union of the lower most branching site, iii) single leaf area (cm²) from the middle of the top most mature flush (average of five flushes) using LI-3000 Area meter, iv) girth (cm) of the plant at a height of 30 cm above the bud union, v) bark thickness (mm) at tapping height, vi) number of laticifer rows and vii) test tap yield (average of 5 tappings) at 30 cm height above the bud union and expressed in g.

For anatomical observations bark samples were collected at a height of 30 cm from bud union and preserved. Transverse (CS) and radial longitudinal sections (RLS) of bark samples were cut at 40-80 µm thickness with base sledge microtome and stained with Sudan III for microscopic observations.

The data collected were subjected to statistical analysis. Mean values, variability estimates (phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) and the genetic parameters such as heritability (H²) in broad sense and genetic advance (GA) were ascertained according to Singh & Choudhary (1985). Since the plants within genotype were not grown randomly over the environment, the variation among the genotypes with respect to the characters studied was not tested for its significance.

OBSERVATIONS

The range of variation and mean values in wild *Hevea* germplasm along with control is depicted in Table 1. The highest mean value for plant height was recorded in AC 3013 and MT 2226 (7.6 m) and lowest mean values observed in RO 2890 (3.50 m). However, the overall general mean of wild genotypes was equal to that of the control. The mean values for first branching height was lowest in RO 2629 (0.72 m) and highest in MT 2529 (6.50 m) with a general mean value of 2.007 m which was considerably higher than that of the control. Single leaf area showed a wide range of variation with a general mean value of 88.22 cm² which was higher than that of the control. The wild genotypes showed lower general mean values for girth, bark thickness and number of latex vessel rows (TLVR) than that of the control clone RR11-105 though the wild germplasm exhibited superiority over control for each of these traits. Most of the wild genotypes gave very low or negligible yield on test tapping. However RO 2629 came very close to the control for this trait.

TABLE 1: Range of variation and mean in wild *Hevea* germplasm.

| Character | Wild genotypes | | General mean | Control (RR11 105) mean |
|------------------------------|-----------------|--------------------------|--------------|-------------------------|
| | Minimum | Maximum | | |
| Height (m) | 3.50 (RO 2890) | 7.60 (AC 3013 & MT 2226) | 5.85 | 5.86 |
| First branching height (m) | 0.72 (RO 2629) | 6.50 (MT 2529) | 2.07 | 0.86 |
| Leaf area (cm ²) | 46.37 (RO 2729) | 152.48 (AC 2686) | 88.22 | 65.51 |
| Girth (cm) | 14.34 (RO 2906) | 27.70 (MT 2217) | 19.26 | 21.54 |
| Bark thickness (mm) | 2.06 (RO 3032) | 4.80 (RO 2629) | 3.25 | 4.10 |
| TLVR | 3.20 (RO 3032) | 7.60 (MT 2217) | 4.55 | 6.00 |
| Yield (g) | 0.05 (RO 2856) | 1.57 (RO 2629) | 0.17 | 1.70 |

TABLE 2: Comparison of range and mean values between the three provenances.

| Character | Provenances | | |
|------------------------------|----------------------|----------------------|----------------------|
| | Acre | Matto Grosso | Rondonia |
| Height (m) | 4.50-7.60 (6.05) | 4.43-7.60(6.27) | 3.50-7.50 (5.65) |
| First branching height (m) | 1.55-5.40 (2.47) | 0.94-6.50 (2.53) | 0.72-3.55 (1.81) |
| Leaf area (cm ²) | 58.77-152.48 (97.47) | 48.78-136.08 (77.18) | 46.37-147.39 (88.23) |
| Girth (cm) | 16.80-25.40 (19.82) | 15.74-27.70 (21.36) | 14.34-25.40 (18.36) |
| Bark thickness (mm) | 2.50-3.90 (3.19) | 2.50-4.60 (3.51) | 2.06-4.80 (3.19) |
| TLVR | 3.60-5.80 (4.31) | 3.60-7.60 (5.17) | 3.20-6.00 (4.45) |
| Yield (g) | 0.05-0.17 (0.08) | 0.09-0.98 (0.29) | 0.05-1.57 (0.14) |

Figures in parantheses are mean values.

TABLE 3 : Mean values, phenotypic and genotypic coefficient of variation, heritability and genetic advance.

| Character | Mean | PCV | GCV | Heritability (%) | Genetic advance (as % of mean) |
|------------------------------|-------|--------|--------|------------------|-----------------------------------|
| Height (m) | 5.85 | 18.50 | 13.81 | 55.69 | 27.20 |
| First branching height (m) | 2.08 | 0.63 | 0.46 | 54.84 | 90.36 |
| Leaf area (cm ²) | 88.23 | 36.00 | 23.95 | 44.27 | 42.07 |
| Girth (cm) | 19.26 | 19.72 | 12.93 | 42.97 | 22.38 |
| Bark thickness (mm) | 3.26 | 20.48 | 13.35 | 42.48 | 22.97 |
| TLVR | 4.56 | 21.42 | 13.39 | 39.11 | 22.12 |
| Yield (g) | 0.17 | 163.33 | 148.47 | 82.63 | 356.29 |

A comparison of range and mean values between three provenances of Brazil is shown in Table 2. The genotypes from Matto Grosso recorded higher values for all the traits except single leaf area. The mean values for single leaf area was the highest in Acre genotypes and lowest in Matto Grosso genotypes. An estimate of various genetic parameters for 7 characters in wild populations of *Hevea* is depicted in Table 3. High phenotypic and genotypic coefficients of variation was observed in all characters except for first branching height. A high phenotypic coefficient of variation was observed in case of yield (163.33) and single leaf area (36.00) whereas it was very low for the character first branching height (0.63). Similar trend was also observed for genotypic coefficient of variation. Medium to high heritability values were observed for all the seven traits. Yield showed the highest heritability, while total latex vessel rows showed the lowest. High genetic advance was expressed by the traits yield and first branching height.

DISCUSSION

The wild genotypes generally had lower girth, bark thickness, number of latex vessel rows and

yield than the control clone. However, these wild genotypes generally had larger leaves and tended to branch at a much higher than the control RR11-105. A comparison of range and mean values between 3 provenances revealed that the MT genotypes recorded higher values for all the traits except single leaf area. This is in accordance with the earlier observations made by Abraham et al. (1992). Clement-Damange et al. (1990) have also reported that MT genotypes yield more than the AC and RO genotypes. The highest mean value for juvenile yield was recorded in Matto Grosso genotypes (0.29 g) and lowest in Acre genotypes (0.08 g). Rondonian genotypes (0.14 g) appeared to be intermediate in the mean values between Acre and Matto Grosso genotypes. Chevallier (1988) also reported the intermediate position of the Rondonian genotypes and their higher heterogeneity compared to the other 2 provenances. Association of high heritability with high genetic advance, observed for yield indicate the predominance of additive gene effects in controlling the trait. Medium H^2 with low GA was observed for yield contributing traits such as girth and TLVR indicating that these characters are controlled by non-additive gene action, for which recombinant breeding will be more successful.

The present investigation reveals that wide range of variability exists in wild populations of *H. brasiliensis*. Matto Grosso genotypes performed well for most of the traits studied. A judicious selection and use of these diverse promising materials with genes for yield along with other desirable traits would bring about substantial improvement in the productivity of this crop.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. M.R. Sethuraj, Director Rubber Research Institute of India, for providing necessary facilities and encouragement during the course this investigation. Thanks are due to Sri M.J. George, Dy Director, Central Experiment Station for local facilities provided. Dr. P.R. Suresh, Jr. Scientist and Dr. Shushil Kr. Dey, Environmental Physiologist for the help rendered in the preparation of the paper also acknowledged. The assistance rendered by Smt. K.P. Leelamma, Assistant Technical Officer is acknowledged.

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