

PROVENANCE VARIATION OF WILD *HEVEA* GERMPLASM IN A DRY SUB HUMID REGION OF INDIA

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Introduction

The genus *Hevea* has around 10 species. These species occupies the Amazon basin and parts of the adjacent uplands, penetrating north of the river in the west of manaos. Commercial production of rubber is obtained from one cultivated species *Hevea brasiliensis*. Rubber is chiefly used for manufacturing of automobile tires, tubes, foot wears, mattress, battery cases, contraceptives and thousands of essential minor to major articles for various machines and day to days various other domestic uses. It is mainly grow in small holdings in India. However, because of high socio-economic importance, production of rubber has increased during the last decades. The high yielding varieties and expansion of area under rubber cultivation has played a vital role in higher productivity.

Few seeds, collected by Sir Henry Wickham from a limited area, compared to the large spread of the species in its natural habitat, represents a very small gene pool (Schultes, 1977), are the original source of all the cultivated *Hevea* clones in the far-east. Intensive directional selection for yield alone, over the years, ignoring the genetic variability with regard to secondary characters (Wycherley, 1969), has further narrowed the genetic base. Conscious of the narrow genetic base and reports of constant threat to the survival of the genus in the centers of origin (Wycherley, 1977), the International Rubber Research and Development Board (IRRDB) organized a major collection expedition to the centre of origin, the Amazon rain forest in Brazil, and a large number of accessions from various provenances of wild *Hevea brasiliensis* were collected during 1981.

The main objective of this work was to evaluate different accessions of various provenances of wild *Hevea* to assess the nature and extent of variability under the stress conditions of dry sub humid climate; and for the further identification of accessions for the future breeding programmes. This is the first report on provenance variability of wild *Hevea* germplasm in the dry sub humid climate.

Material and Methods

The experimental material comprised 56 accessions of wild *Hevea* representing Acre, Mato Grosso and Rondonia provenances and 2 commercial rubber clones (Table 1). These accessions and commercial clones were bud grafted and the stumps were raised in the poly bags. The successfully established plants were transplanted in the field nursery of the Regional Research Station of Rubber Research Institute of India at Sukma (19°5'N, 82° 02' E, 202 m amsl) in the Bastar region of central-eastern India. The region is a typically non-traditional and experiences high temperature during summer, low rainfall (Table 2) and prolonged drought period.

Table 1
*The source and numbers of wild Hevea
accessions evaluated*

Source	Accessions
Acre	AC 619, AC 668, AC 685, AC 607, AC 623, AC 707
(Amazon basin, Brazil)	AC 162, AC 158, AC 175, AC 177, AC 68, AC 1950
	AC 2584, AC 2585, AC 5463, AC 5525
Mato Grosso	MT 44, MT 58, MT 60, MT 69, MT 180, MT 190
(Amazon basin, Brazil)	MT 196, MT 202, MT 999, MT 221 7, MT 2229
	MT 2529, MT 2594
Rondonia	RO 27, RO 36, RO 25, RO 284, RO 217, RO 876
(Amazon basin, Brazil)	RO 2635, RO 2822, RO 2810, RO 2890, RO 3172
	RO 2629, RO 5369, RO 5363, RO 5348, RO 5329
	RO 5430, RO 5445, RO 5400, RO 5426, R O 5408
	RO 5424, RO 5553, RO 5557, RO 5554, RO 6139
	RO 6114
Commercial clones	RRII 105, GT 1

In the nursery, the wild accessions and commercial clones were planted at spacing of 60 cm x 120 cm and with a plot size of 10 trees. All cultural operations were carried out uniformly as per standard prescribed procedures (Rubber Board, 1995). Data were recorded on five randomly selected plants at the age of six months after nursery field planting. Observations were made on scion height (cm), girth (cm) of scion at a height of 15 cm, number of flushes, total number of leaves and leaf area (cm²) of middle leaflets of two leaves from the middle of the topmost mature flush. Correlation matrix, variability

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Table 2
Average temperature and rainfall during the experimental period (1996-97).

Month	Rainfall (mm)	Temperature (°C)	
		Min.	Max.
January	13.5	12.2	27.4
February	...	13.6	31.0
March	27.0	18.3	35.7
April	75.3	20.9	34.8
May	39.2	25.6	38.8
June	274.2	24.2	33.9
July	484.7	23.1	29.0
August	322.1	22.5	28.0
September	237.6	22.6	30.0
October	27.4	21.4	29.3
November	49.8	16.8	28.8
December	14.5	13.2	26.9
Total	1565.3	...	...
Mean	...	19.5	31.1

estimates and heritability in broad sense were ascertained according to Panse and Sukhatme (1978).

Results and Discussion

The mean minimum and maximum values of quantitative traits are shown in Table 3. Significant variability was observed among the wild accessions with respect to all the characters studied except leaf area. Among the different genotypes, the trait girth ranged from 3.84 cm (AC 685) to 8.00 cm (RO 876), scion height 133.4 cm (AC 158) to 292.37 cm (RO 897), number of leaves 11.0 (AC 623) to 51.75 (RO 876) and leaf area from 85.49 cm² (MT 58) to 195.60 cm² (AC 623). General mean values for scion height and leaf area were found higher in wild accessions as compared to commercial clones. The wild accessions appeared to be more vigorous than the commercial clones. The higher vegetative vigor of wild genotypes over the commercial clones could be attributed to the diverse nature of the wild germplasm (Annamma *et al.*, 1989). Earlier studies on some of the young wild genotypes of Rondonia and Mato Grosso provenances at nursery stage (Annamma *et al.*, 1989)

and among the three provenances also showed wide variability with respect to certain growth characters of wild germplasm (Chevallier, 1988).

The observations revealed wide inter and intra provenance variations for all the growth traits (Table 4). The genotypes from Rondonia provenance were found to be very vigorous except leaf area, with highest provenance mean values for girth (5.88 cm), scion height (216.57 cm), number of flushes (4.83) and number of leaves (30.76). The mean value for leaf area was the highest in Acre provenance and lowest in Mato Grosso genotypes. However, highest variability for all the traits was noted for the Rondonia provenance. The general mean values for most of the traits were higher in Mato Grosso closely followed by Rondonia provenance. The Acre genotypes showed lowest growth figures among the provenances. Nicholas *et al.* (1988) and Omokhafa (1991) reported similar results of highest variability in Rondonia provenance at nursery stage.

Correlation coefficients between pairs of the traits, girth, scion height and number of flushes were found high and were also significant both for the provenances and the entire wild population (Table 5). Positive correlation between these traits for the three provenances indicates that improvement in one trait can be achieved indirectly by selecting for the second trait. Significant positive correlation between these characters has also been reported for the wild genotypes of Acre, Mato Grosso and Rondonia provenances at nursery stage (Omokhafa, 1991).

An estimation of various genetic parameters for the traits depicted in Table 6. A high phenotypic coefficient of variation was observed for number of leaves (45.25) and leaf area (30.88) whereas it was moderate for rest of the traits. Similarly, comparison of the magnitude of genotypic coefficient of variation revealed the higher and moderate values for number of leaves (32.34), scion height (19.71) and girth (16.64), respectively. The existence of high genetic variability was evidenced by moderate to high estimates of phenotypic coefficient of variation and genotypic coefficient of

Table 3
Range and mean of variation for quantitative traits in wild *Hevea* accessions at the nursery stage.

Traits	Wild accessions			Commercial clones		CV %
	Minimum	Maximum	General mean	RRII 105	GT 1	
Girth (cm)	3.84 (AC 685)	8.00 (RO 876)	5.35	5.25	5.33	11.513
Scion height (cm)	133.40 (AC 158)	292.37 (RO 876)	200.49	149.05	188.57	16.100
No. of flushes	3.25 (RO 2890)	6.00 (RO 217)	4.48	4.25	5.00	20.328
No. of leaves	11.00 (AC 623)	51.75 (RO 876)	22.90	28.50	32.50	31.661
Leaf area (cm ²)	85.49 (MT 58)	195.60 (AC 623)	134.11	113.32	111.12	32.301

Table 4
Mean and range of variability for morphological traits between the three provenances.

Traits	Provenance					
	Acre		Mato Grosso		Rondonia	
	Mean	Range	Mean	Range	Mean	Range
Girth (cm)	5.06	3.84 - 5.77	5.11	4.44 - 5.88	5.88	4.24 - 8.00
Scion height (cm)	181.93	133.40 - 274.97	202.97	146.73 - 283.07	216.57	151.17 - 292.37
No. of flushes	4.15	3.75 - 5.25	4.48	3.50 - 5.50	4.83	3.25 - 6.00
No. of leaves	17.80	11.00 - 29.75	20.19	15.00 - 24.75	30.76	12.50 - 51.75
Leaf area (cm ²)	136.32	108.95 - 195.60	134.91	85.49 - 172.36	131.11	88.74 - 179.75

Table 5
Inter character correlation coefficients for wild genotypes.

Traits	Provenance/ Population	Ttraits			
		Scion height	No. of flushes	No. of leaves	Leaf area
Girth	Acre	0.519*	0.580*	0.495	0.390
	Mato Grosso	0.669*	0.692**	0.776**	-0.428
	Rondonia	0.761**	0.629**	0.339	0.550**
	Population	0.676**	0.660**	0.536**	0.264**
Scion height	Acre		0.468	0.405	0.172
	Mato Grosso		0.713**	0.770**	-0.115
	Rondonia		0.716**	0.482*	0.249
	Population		0.690**	0.546**	0.111
No. of flushes	Acre			0.858**	-0.458
	Mato Grosso			0.815**	-0.367
	Rondonia			0.748**	0.104
	Population			0.781**	-0.136
No. of leaves	Acre				-0.532
	Mato Grosso				-0.127
	Rondonia				-0.105
	Population				-0.214

* Significant at 5% level.

**Significant at 1% level.

variation for most of the traits.

Broad sense heritability was estimated for all the traits (Table 6). A comparison revealed that girth and scion height had the higher values of 0.67 and 0.59, respectively and comparatively lower values were observed for number of flushes and leaf area. High heritability observed for girth and scion height indicates the predominance of

Table 6
Phenotypic and genotypic coefficients of variation and heritability for different traits.

Traits	PCV	GCV	Heritability (H ²)
Scion height	25.47	19.71	0.59
Girth	20.23	16.64	0.67
No. of flushes	23.74	11.81	0.24
No. of leaves	45.25	32.34	0.51
Leaf area	30.88	10.74	0.12

additive gene effect in controlling the traits.

The present observations in wild *Hevea* accessions revealed wide variability and higher vigor in terms of higher mean values for all the traits except number of leaves, over the commercial clones. Among the three provenances, Rondonia exhibited superiority for most of the traits. The potential value of genes from wild accessions is undoubted. Therefore the higher variability for these traits would be desirable material in breeding cycles.

Conclusion

The present results indicated the presence of large genetic variability in wild species. Among the three provenances, Rondonia exhibited superiority for most of the traits. In view of the availability of collected germplasm by IRRDB, attempts are needed to use the potential of genes from wild species. A judicious selection of the promising diverse material could be useful in future breeding programme.

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SUMMARY

An evaluation at nursery stage of 56 wild accessions of 3 provenances of Amazon basin, Acre (AC), Rondonia (RO) and Mato Grosso (MT) of wild *Hevea brasiliensis* (Para Rubber) and 2 rubber commercial clones was carried out at the Regional Research Station of Rubber Research Institute of India located at Sukma, a drought prone area under dry sub humid region of Bastar district in central-eastern India to obtain information about potential of variability in quantitative traits. Among the different accessions, girth ranged from 3.84 cm (AC 685) to 8.0 cm (RO 876), scion height 133.4 cm (AC 158) to 292.37 cm (RO 897), number of leaves 11.0 (AC 623) to 51.75 (RO 876) and leaf area from 85.49 cm² (MT 58) to 195.60 cm² (AC 623). The observations revealed wide inter and intra provenance variations for all the quantitative traits. The existence of high variability was evidenced by moderate to high estimates of phenotypic and genotypic coefficient of variation for the traits. High heritability was observed for girth and scion height. Among the three provenances, Rondonia exhibited superiority for most of the traits. A judicious selection of these promising diverse materials would be useful in future breeding programmes.

Key words : *Hevea*, wild germplasm, provenance, variability, heritability.

भारत के शुष्क उपार्द्र क्षेत्र में जंगली रबर बीजों की स्थानगत विभिन्नता

बी. कृष्णा, के.एन. राव, जी.पी. राव व एम.ए. नजीर

सारांश

अमेजन नदीघाट की 3 जगहों से लिए जंगली *हीविया ब्राजीलियेंसिस* (रबर) के 56 जंगली पौधों, एकरे (एसी) रोंडोनिया (आरओ) और मातोग्रोसो (एम टी) और 2 व्यापारिक कृन्तओं को रोपणी स्तर पर मूल्यांकन मध्य पूर्ववर्ती भारत के बस्तर जिले में, सूखा पड़ते रहने वाले क्षेत्र में, शुष्क उपार्द्र क्षेत्र में, उनकी मात्रात्मक लक्ष्यों या विशेषताओं का पता लगाने के लिए रबर अनुसंधान संस्थान, सुकमा के अनुसंधान केन्द्र पर किया गया। विभिन्न पौधों में गोलाई या परिधि 3.84 सेमी. (एसी 685) से लगाकर 8.0 सेमी. (आरओ 876) तक, टुकड़े की ऊँचाई 133.4 सेमी (एसी 158) से लगाकर 292.37 (आरओ 897) तक पत्तियों की संख्या 11.0 (एसी 623) से लगाकर 51.75 (आरओ 876) तक तथा पर्णक्षेत्र 85.49 सेमी² (एमटी 58) से लगाकर 195.60 सेमी² (एसी 623) तक रही। इन पर्यवेक्षणों से पता चला कि सभी लक्षणों की दृष्टि से विभिन्न स्थान भेदों और वहाँ से लिये पौधों के अन्दर भी अन्तर पाया जाता है। अधिक विभिन्नता पाया जाना दृश्यरूप और समपिनक में लक्षणों की विभिन्नता के गुणांकों में मध्यम से अधिक आंकलनों तक मिला। परिधि और पौधे की लम्बाई ऊँचाई में अधिक पैतृकता आती देखी गई। तीनों स्थान भेदों में से रोण्डोनिया में अधिकांश लक्षणों या विशेषताओं की श्रेष्ठता मिली भविष्य के प्रजनन कार्यक्रमों इन उत्साहप्रद विभिन्न सामग्रियों में से सुझबूझ से चुनाव करना लाभप्रद रहेगा।

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