Natural Rubber Research, **22** (1&2): 133-139, 2009

EARLY PERFORMANCE OF WILD *HEVEA* GERMPLASM IN THE SUB-HIMALAYAN CLIMATE OF WEST BENGAL

Gitali Das, R.S. Singh*, G. C. Mondal, D. Chaudhuri** and M. A. Nazeer*****

Rubber Research Institute of India, RES, Nagrakata, Jalpaiguri - 735 225, West Bengal, India
*Rajendra Prasad Agriculture University, Pusa, Samastipur, Bihar, India
**Rubber Research Institute of India, RRS, Guwahati - 781 006, Assam, India
***Rubber Research Institute of India, Kottayam - 686 009, Kerala, India

Das, G., Singh, R.S., Mondal, G.C., Chaudhuri, D. and Nazeer, M.A. (2009). Early performance of wild *Hevea* germplasm in the sub-Himalayan climate of West Bengal. *Natural Rubber Research*, **22**(1&2): 133-139.

The performance of 21 wild *Hevea* germplasm accessions was evaluated under biotic and abiotic stress conditions in the sub-Himalayan West Bengal at the Experimental Station of Rubber Research Institute of India, Nagrakata, Jalpaiguri, West Bengal. Assessment of these genotypes for yield and other secondary characters has indicated superiority of one accession, RO 5363, for yield. Both test tap yield for three years and normal tapping for two years showed stability. The rest of the germplasm accessions were inferior to the control clone RRII 105. The accession RO 3172 was the most vigorous and had the highest girth, girth increment and number of tappable trees, though the yield was very low. The accession AC 1950, though showing fairly good yield, did not have good bark thickness and girth. Only three accessions showed tolerance to *Oidium* leaf disease, even after sulphur dusting. Selected genotypes might be used for future breeding programme.

Keywords: Climate, Clone, Germplasm, Growth, *Hevea*, Selection, Yield.

INTRODUCTION

The genetic base of cultivated *Hevea* in the East is presently limited to the few seedling trees survived from the original collection from the Amazonian rain forests in Brazil (Wycherley, 1968; Allen, 1984). From this small base, remarkable yield improvement has been achieved (Varghese, 1992). However, development of crop varieties tolerant/resistant to different biotic and abiotic stresses is inevitable in achieving the twin goals of high crop productivity and of sustainability in adverse situations. The wild germplasm from the Amazon basin was introduced into India for widening the genetic base of rubber.

Rubber cultivation has been extended to non-traditional and marginal lands like the north - eastern states, where it is exposed to various biotic and abiotic stress situations. Thus, development of genotypes suitable for specific regions attains importance. With this in view, a few wild *Hevea* germplasm accessions were planted in Nagrakata,

Correspondence: Gitali Das (Email: gitali_das@rediffmail.com)

Jalpaiguri, West Bengal to evaluate them on the basis of primary characters like girth, bark thickness, disease incidence and early yield potential. An earlier study on growth performance of these accessions in the immature phase showed that accessions from Acre were more vigorous than those from Mato Grosso and Rondonia but were not better than the check clone (Gohain *et al.*, 2005). Based on the performance of these accessions in the early yielding phase, selected genotypes showing desirable characters will be selected and used for future breeding programmes.

MATERIALS AND METHODS

The experiment was conducted at the Regional Experiment Station, Nagrakata, West Bengal in 1998 using 21 genotypes including one check clone (RRII 105) in RBD with two replicates having eight plants in each replication. Recommended cultural practices were followed for maintenance of the trial. The land was level with homogenous soil status. The accessions planted in the trial are listed in Table 1. The annual girth data of the plants at 150 cm height and bark thickness of all the tapped plants at panel opening in the ninth year and at eleventh year of growth were recorded. The data were subjected to statistical analysis. The meteorological data of the station during the experimental period was also recorded.

Disease incidence was scored following the standard method. The incidence and severity of powdery mildew disease was assessed from five twigs having immature top whorl leaves selected at random from each plant during peak time of the disease. For a visual scoring and classification of severity, a scale of 1 to 5 was used where 1= 0% (no infection), 2 = 1 to 15%, 3 = 16 to 30%, 4 = 31 to 50% and 5 = 51% and above leaf area infected. For estimation of severity the sum of infection grades of each sample was divided by the total number observed, which included both infected and non-infected leaves (Samaradeewa *et al.*, 1985).

Table 1. **Details of genotypes**

Provenance	Accession	Total
Acre	AC 68, AC 607, AC 619, AC 623, AC 763, AC 1950	6
Mato Grosso	MT 44, MT 196, MT 2229, MT 2594	4
Rondonia	RO 2629, RO 2635, RO 2890, RO 3172, RO 5148, RO 5329, RO 5363, RO 5408, RO 5430, RO 5557, RO 6139	11
Check clone	RRII 105	1

Table 2. **Meteorological data of northern part of West Bengal (Nagrakata) (1998 - 2008)**

	T_{max} (°C)	T_{min} (°C)	Sunshine (h)	Wind speed (m/s)	Annual rainfall (mm)	Rainy months
Mean	29.4	18.1	5.4	1.73	3710	May-September
Range	19.3 -34.6	4.2 - 27.7	0 - 18.4	0 - 8.9	1378 - 4403	11*

*Total rainy days in other months

Juvenile tapping was done at fifth year of growth during winter (December) for three consecutive years at a height of 30 cm from base in S/2 d2 7d/7. As the objective of the study was to assess the performance of accessions during severe winter period, the juvenile-tap yield was recorded during December. The yield of the first five tappings was discarded. The juvenile yield data on daily-basis were collected from sixth tapping till fifteenth tapping after which it was discontinued. Mature yield of all the genotypes was collected from ninth year of growth once in a month in S/2 d2 6d/7 system of tapping for two years. The monthly yield at juvenile and mature stages was taken in the form of fresh cup lump and after sheeting, dried in smoke house to get the dry weight. The girth, bark thickness and yield data were then subjected to analysis of variance.

Table 3. **Variability in growth of different wild *Hevea* germplasm accessions**

Accession	Girth (cm)				Bark thickness (mm)
	At opening (9^{th} year)	At 11^{th} year	Per cent of plants showing > 45 cm at opening	Increment from 9^{th} to 11^{th} year (cm/year)	
AC 1950	51.7	57.0	75	2.7	4.5
AC 607	27.9	32.7	(0)	2.4	4.2
AC 619	46.4	54.3	63	4.0	4.8
AC 623	40.3	43.6	13	1.7	4.4
AC 68	53.4	59.9	81	3.2	5.6
AC 763	44.8	50.1	44	2.6	4.9
Population mean	44.1	49.6	46	2.8	4.7
MT 196	46.3	55.8	56	4.8	3.3
MT 2229	54.1	56.8	75	0.8	5.0
MT 2594	38.8	47.6	25	4.4	3.9
MT 44	53.0	60.9	69	3.9	3.9
Population mean	48.1	55.3	56	3.5	4.0
RO 2629	55.1	63.9	69	4.4	5.4
RO 2635	54.1	62.5	69	4.2	5.0
RO 2890	56.1	65.2	81	4.6	4.3
RO 3172	55.7	66.7	88	5.5	4.1
RO 5329	48.2	52.9	75	2.3	4.2
RO 5348	55.1	63.3	75	4.1	5.3
RO 5363	55.1	58.6	63	1.8	6.0
RO 5408	45.3	48.5	63	1.6	4.4
RO 5430	53.9	61.9	75	4.0	4.3
RO 5557	57.5	65.0	50	3.8	4.8
RO 6139	44.1	51.0	31	3.5	3.4
Population mean	53.2	60.4	67	3.6	4.7
RRII 105	55.1	54.1	50	1.8	5.3
CD (P = 0.05)	NS	0.6	7.3	2.1	NS

RESULTS AND DISCUSSION

The agrometeorological data of the Station during the experimental period is tabulated in Table 2. The Station is situated at 26° 43'N latitude, 88° 26'E longitude and altitude of 69 m above MSL. The mean maximum and mean minimum temperatures during the experimental period were 29.4 and 18.1° C, respectively. The range values indicate wide variation in minimum temperature at this region. The area received a mean annual rainfall of 3710 mm, well distributed over months from May to September. The whole data indicates that with wide fluctuation in mean minimum temperature, heavy rainfall and fairly high wind speed and sunshine, the climate is quite different from the other traditional rubber growing tracts, but is still hydrothermally suitable for rubber cultivation. Rao *et al.* (1993) also came to the same conclusion in an earlier study.

Significant differences in girth were noticed between different groups of accessions (Table 3). The data on mean girth at the time of opening in different accessions showed a range of 27.9 – 57.5 cm while the check clone RRII 105 had a girth of 55.1cm. In the eleventh year, RO 3172 had the highest girth (66.7 cm), followed by RO 2890 and RO 5557 (65.2 and 65.0 cm respectively), while RRII 105 had a girth of 54.1 cm. RO 3172 also had the highest rate of girth increment (5.5 cm/year). Girth of Rondonia (RO) series was the highest followed by Mato Grosso (MT). The average performance of Acre (AC) accessions was inferior to that of RRII 105. Rondonia had the highest percentage of tappable trees at the time of opening (67%), followed by Mato Grosso (56%) and Acre (46%). Only 50% of the trees in RRII 105 attained tappability at the time of opening. Among the individual accessions, RO 3172 had the highest percentage of tappable trees. There was no significant difference in bark thickness between the accessions. The data on growth performance at the early yielding phase in different accessions showed that

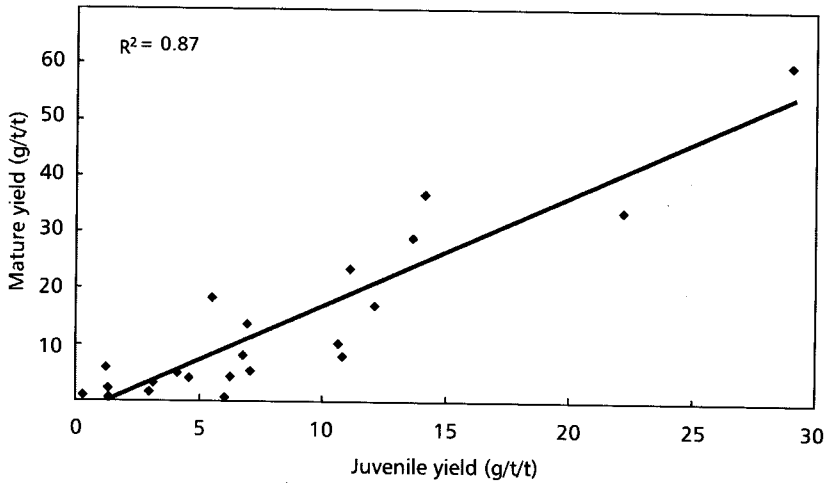

Fig. 1. Correlation between juvenile and mature yield in different accessions

the overall performance of Rondonia was the best, followed by RRII 105, Mato Grosso and Acre. However, during the juvenile phase, Acre showed better performance in terms of girth, plant height, number of leaves and leaves per whorl than the accessions from the other two provenances and the check clone (Gohain *et al.*, 2005).

Juvenile tapping is one of the methods used to assess the yield potential of rubber plants in the early stages of growth (Nazeer *et al.*, 1992). Among the wild accessions studied (Table 4), significantly higher yield at juvenile stage was observed in RO 5363 (29.0 g/t/t) followed by RRII 105 (24.2 g/t/t), AC 1950 (13.6 g/t/t) and AC 763 (12.1 g/t/t). RO 5363 also showed the highest yield in mature stage (59.7 g/t/t) over two years. This was followed by the check clone RRII 105 with 43.2 g/t/t. In a similar study in the drought region of central-eastern India (Sukma, Bastar region), the performance of accession RO 5363 was found to be comparable with the check clones RRII 105 in terms of growth and early yield (Rao *et al.*, 2006). Figure 1 shows the correlation between juvenile and mature yield in the population. The high R^2 value of 0.87 indicates that juvenile yield is a fair indicator of mature yield.

The incidence of powdery mildew disease and its severity under sulphur-dusted condition are given in Table 5. All the wild accessions of *Hevea* germplasm were found to be affected by powdery mildew disease with varying intensity. Out of 21 wild accessions studied, the severity of powdery mildew disease was found to be as high as 3.5 in AC 623 indicating that this accession was the most susceptible to the disease. The accessions RO 5348, MT 44 and MT 196 showed less severity of infection (grade below 1.6). The genotypes AC 619 and RO 5408 scored 2.9 and 2.7 indicating their susceptibility to *Oidium* disease. In general, the Rondonia group was more susceptible to *Oidium* disease

Table 4. **Yield potential of different accessions of *Hevea* germplasm**

Accession	Test tap yield (g/t/t)	Yield over two years (g/t/t)
AC 1950	13.6	29.1
AC 607	0.3	1.0
AC 619	1.3	2.0
AC 623	1.3	0.7
AC 68	4.2	5.4
AC 763	12.1	17.1
Population mean	5.5	9.2
MT 196	5.5	18.2
MT 2229	10.8	8.2
MT 2594	2.6	6.0
MT 44	6.7	8.1
Population mean	6.4	10.1
RO 2629	7.1	5.2
RO 2635	3.0	1.6
RO 2890	4.1	4.9
RO 3172	1.2	0.6
RO 5329	6.9	13.8
RO 5348	6.0	0.8
RO 5363	29.0	59.7
RO 5408	6.3	4.4
RO 5430	10.6	10.3
RO 5557	3.2	3.0
RO 6139	4.6	4.0
Population mean	7.5	9.8
RRII 105	24.2	43.2
CD (P = 0.05)	2.92	5.08

(population average being 2.8) than that in MT (1.6) and AC (1.9).

It is interesting to note that the accession RO 5363 ranked first in terms of yield (juvenile and mature) and had a relatively high girth. The check clone RRII 105 had high yield, but low girth (Table 4). The accession RO 3172 was the most vigorous with the highest girth, girth increment rate after tapping as well as maximum number of tappable trees at the time of opening. However, the yield was very low. This accession can be used in crop improvement programme. In the climatic conditions of China where cold wave is common, Zeng *et al.* (2005) observed that in general the 1981 IRRDB germplasm exhibited poor growth compared to the Wickham clones. A wide range of variability in different characters is a common factor for different accessions of rubber when nurtured in any climatic condition. Such variation was also observed in the traditional rubber growing regions of India (Varghese, *et al.*, 1989), China (Hu *et al.*, 2005; Zeng *et al.*, 2005) and Malayasia (Ong and Tan, 1987).

CONCLUSION

Screening of 21 wild germplasm along with a check clone at juvenile and mature stage showed that only one accession, RO 5363, ranked high in all aspects. The rest of the germplasm was inferior to the check clone RRII 105. Correlation between juvenile and mature yield (mean over two years) revealed that there was significant correlation between these two traits. The selected accessions may be utilised in breeding programme for developing high yielding clones with better secondary characteristics.

Table 5. **Severity of powdery mildew disease in different *Hevea* accessions**

Accession	Severity of powdery mildew disease (Mean of 3 years)
MT 44	1.4
RO 5348	1.5
MT 196	1.5
RO 3172	1.6
AC 68	1.6
MT 2229	1.6
AC 607	1.7
AC 763	1.7
MT 2594	1.9
RO 5430	2.0
RO 5557	2.1
RO 2629	2.2
RO 2890	2.2
RO 5329	2.2
RO 6139	2.2
PB 260	2.2
RO 2635	2.3
RO 5363	2.3
RRII 105	2.3
AC 1950	2.4
RO 5408	2.7
AC 619	2.9
AC 623	3.5

ACKNOWLEDGEMENT

The authors are thankful to Dr. James Jacob, Director of Research for his help in conducting the experiment. Thanks are due for Dr. Y. Annamma Varghese, former Joint Director (Crop Improvement) for her constant encouragement. The help of all the scientists associated in the initial phase of the trial and the field staff is also acknowledged.

REFERENCES

Allen, P.W. (1984). Fresh germplasm for natural rubber. *Span,* **27**(1): 7-8.

Gohain, T., Meti, S, Kishan, B., Rao, K.N. and Nazeer, M.A. (2005). Early performance of some germplasm accessions in Dooars region of West Bengal. *Natural Rubber Research,* **18**(2): 188-190.

Hu, Y., Zeng, X., Chen, H., Fang, J. and Huang, H. (2005). A study report on the main characters evaluation of new Amazon *Hevea* germplasm. *Preprints, International Natural Rubber Conference,* 6-8 November 2005, Cochin, Kerala, India, pp. 50-54.

Nazeer, M.A., Marattukalam, J.G., Chandrashekar, T.R., Mydin, K. K., Premakumari, D. and Panikkar, A.O.N. (1992). Early growth performance of some *Hevea* clones in Konkan region of Western India. *Indian Journal of Natural Rubber Research,* **5**(1&2): 223-228.

Ong, S. and Tan, H. (1987). Utilization of *Hevea* genetic resources in the RRIM. *Malaysian Applied Biology,* **16**: 145-155.

Rao, P.S., Jayarathnam, K. and Sethuraj, M.R. (1993). An index to assess the areas hydrothermally suitable for rubber cultivation. *Indian Journal of Natural Rubber Research,* **6**(1&2): 80-91.

Rao, G.P., Krishan, B., Nazeer, M.A. and Varghese, Y.A. (2006). Early growth and yield performance of *Hevea* germplasm in a drought-prone region of central-eastern India. *Journal of Plantation Crops,* **34** (3): 192-197.

Samaradeewa, P.K., Liyanage, A.de.S. and Wickremasinghe, W.N.(1985). Relationship between the incidence and severity of *Colletotrichum gloeosporioides* leaf disease in *Hevea brasiliensis. Journal of Rubber Research Institute of Sri Lanka,* **63**: 1-8.

Varghese, Y.A. (1992). Germplasm resources and genetic improvement. In: *Natural Rubber: Biology, Cultivation and Technology* (Eds. M.R. Sethuraj and N.M. Mathew), Elsevier, Amsterdam, pp. 88-115.

Varghese, Y.A., Licy, J., John, A. and Panikkar, A.O.N. (1989). An incision method for early selection of *Hevea* seedlings. *Indian Journal of Natural Rubber Research,* **2**(2): 112-117.

Wycherley, P.R. (1968). Introduction of *Hevea* to the Orient. *Planter,* **44**: 127-137.

Zeng, X., Hu, Y., Huang, H. and Fang, J. (2005). Evaluation of laticifer number of 1981 IRRDB germplasm and relationship analysis with yield, girth and bark thickness. *Preprints, International Natural Rubber Conference,* 6-8 November 2005, Cochin, Kerala, India, pp. 120-127.