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POTENTIAL *HEVEA* CLONES DEVELOPED BY ORTET SELECTION IN ASSAM

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A clonal nursery evaluation was conducted with seven superior ortets selected from a population of 340 seedling trees grown under the agro climatic conditions of Assam in order to evaluate their performance when cloned in comparison to the performance of the original mother tree and a popular check clone. Girth at 5th year of planting and girth increment of the ortet clones, RRSG 9 and RRSG 4 in nursery trial and the corresponding mother trees were significantly higher than that of the check clone RRIM 600. Mean juvenile yield of RRSG 9 with or without stimulation using 2.5 per cent ethephon and the mean yield over 11 years of tapping (mature yield) of the mother tree were significantly higher than that of the check clone. Mean juvenile yield of RRSG 8 without ethephon in nursery trial was significantly higher than RRIM 600 but it was not so in case of mother tree. Juvenile yield of RRSG 8 with 2.5 per cent ethephon was at par with the check clone in the clonal nursery. The performance of RRSG 1 was also noticeable with good pre-monsoon yield. The ortets in the present study maintained the character of their mother tree under bud-grafted condition also, as evidenced by the positive correlation between yield of mother trees and their ortet clones. Clones RRSG 9 and RRSG 8 along with RRSG 1 proved promising for further evaluation in large scale trial.

Keywords: Agroclimate , Mother tree, Nursery trial, Ortet, Yield performance

INTRODUCTION

Selection of offspring following cross pollination is practised in tree breeding programme for exploring chances of identifying the transmitted elite characters in the progeny under the native climatic condition. Polycross seeds developed under native climate is exposed to daily weather conflicts resulting in progeny with adaptive potential (Mydin, 2014). Cross pollination is reported to be advantageous due to production of superior as well as locally adapted progeny (Lloyd and Schoen, 1992). Such ortets which are the products of open pollination selected in a country would be important because they are locally adapted (Jacob *et al.*, 2013). Thus, from a lot of seeds procured from Prang Bazar Isolated Garden (PBIG), Malaysia, twenty two promising clones were developed in India (Mydin *et al.*, 2005; John *et al.*, 2013). Rubber is predominantly a cross pollinated perennial tree, therefore, probability of getting superior polycross progeny is considerable. Thus, a trial was initiated in 1987 with 340 seedling plants to evaluate their potential under the agroclimate of Kamrup, Assam.

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A total of ten mother ortets were selected as highly potential in terms of yield, girth and other secondary attributes over the initial 18 years of growth (Mondal *et al.*, 2006). However, it is highly essential to evaluate the stability of potential characters shown by the first generation ortets, when propagated clonally by budding onto seedling root stocks. Hence, a clonal nursery evaluation trial was initiated with seven superior ortets. This paper reports the performance of these ortets in the immature phase of growth under clonal nursery trial in comparison to the performance of the original mother tree.

MATERIALS AND METHODS

The polycross seedling trial was initiated in the experimental field of Rubber Research Institute of India, Regional Research Station, Guwahati at an altitude of 80 m above MSL longitudinally at 90°52 2 E at a latitude of 26°35 2 N. On the basis of growth and yield over the first 11 years after tapping, seven superior ortets (RRSG 1, RRSG 3, RRSG 4, RRSG 5, RRSG 6, RRSG 8 and RRSG 9) were selected from the polyclonal seedling population (Das *et al.*, 2013). Selected ortets were bud-grafted and were planted in the same area under randomized block design replicated four times at a distance of 1 m x 1 m with six plants per replica in a clonal nursery trial along with a check clone RRIM 600 for comparison in 2008. Girth at 30 cm height was taken annually from individual plants from third year after planting. Test tapping was done on the 3rd year of planting by the modified method of Hammaker-Morris-Mann method during post monsoon (peak yielding) period followed by pre-monsoon (low yielding) period. Fifteen consecutive tappings were conducted in S/2 d2 system at 30 cm height and the first five latex harvest was discarded to initiate yield stabilization. Latex from sixth tapping was cup-coagulated; cuplumps were pooled from each plant from 6th to 15th tappings, smoke dried and weighed for recording the mean of dry cuplump yield from 10 tappings following the procedure described in Mydin *et al.* (2004). Test tapping was conducted two times during pre-monsoon and once in post-monsoon period. During the next post-monsoon period, 2.5 per cent ethephon was applied as the tapping panel in S/2 d3 system of tapping and test tapping yield (juvenile yield) was recorded two days after the application. Coefficient of variance over means was calculated on percentage basis between plants of each ortet clone in each period. Tapping efficiency was calculated considering panel length of each plant (g $tree^{-1}$ tap^{-1} cm^{-1} length of tapping cut). Yield improvement over the control clone was calculated on percentage basis. Analysis of variance was done in MS Excel.

RESULTS AND DISCUSSION

The growth performance showed significant variation between ortet clones. Girth at 5th year of planting ranged from 21.8 to 33.5 cm (Table 1). The girth and girth increment (GI) in RRSG 9 and RRSG 4 were significantly higher than that of RRIM 600. Girth in all other ortet clones was at par with control and except RRSG 3, GI was also at par with control for the rest of the ortet clones. While comparing the performance of ortet clones with their respective mother trees, selected from a base population of 340 trees (Das *et al.*, 2013), it was observed that girth of mother trees of RRSG 4 and RRSG 9 were also significantly higher than that of its check clone RRIM 600. Therefore, the character of high girth of mother trees of these two ortets was maintained within its budgrafted descendants also. Girth of

Table 1. **Growth of ortet clones in juvenile stage as compared to that of their respective mother trees**

Ortet clones	Growth of ortet clones in nursery		
	Girth at fifth year (cm)	Girth increment from 3rd year to 5th year (cm month^{-1})	Girth of original ortets at 22nd year (cm)
RRSG 1	24.7	0.55	104.0 **
RRSG 3	21.8	0.49	103.5 **
RRSG 4	29.2	0.68 *	107.1 **
RRSG 5	24.5	0.58	76.8
RRSG 6	28.2	0.56	86.6
RRSG 8	29.1	0.63	86.6
RRSG 9	33.5	0.70 **	95.8 *
RRIM 600	25.1	0.58	74.4
CD (P ≥0.05)	4.1	0.07	16.01

* = Significant at 0.05 % level
** = Significant at 0.01 % level

mother tree of RRSG 1 and RRSG 3 were also found to be significantly higher than RRIM 600 whereas in ortet nursery, immature girth of these two ortets was at par with RRIM 600.

The juvenile yield of each ortet clone showed wide variation with or without stimulation (Table 2). As the area experiences severe cold during winter, the yield data was collected in two seasons *viz.*, post-monsoon (during November) and pre-monsoon (May) period. In both the periods studied, RRSG 9 showed significantly higher juvenile yield than that of RRIM 600. RRSG 8 was the second highest ranker on juvenile yield though it was at par with that of the check clone during post-monsoon and pre-monsoon period, as the mean yield of these two periods for RRSG 8 was significantly superior to RRIM 600. At present yield improvement by stimulation under low frequency tapping was adopted and proved to be economically viable in mature trees. Effect of yield stimulation at juvenile stage was studied on ortet clones and reported by Nazeer *et al.* (1993). With stimulant (2.5% ethephon) yield in RRSG 9 was the highest compared to that in RRIM 600. Juvenile yield in RRSG 3 was always low. Significantly higher yield was noted in the mother tree of

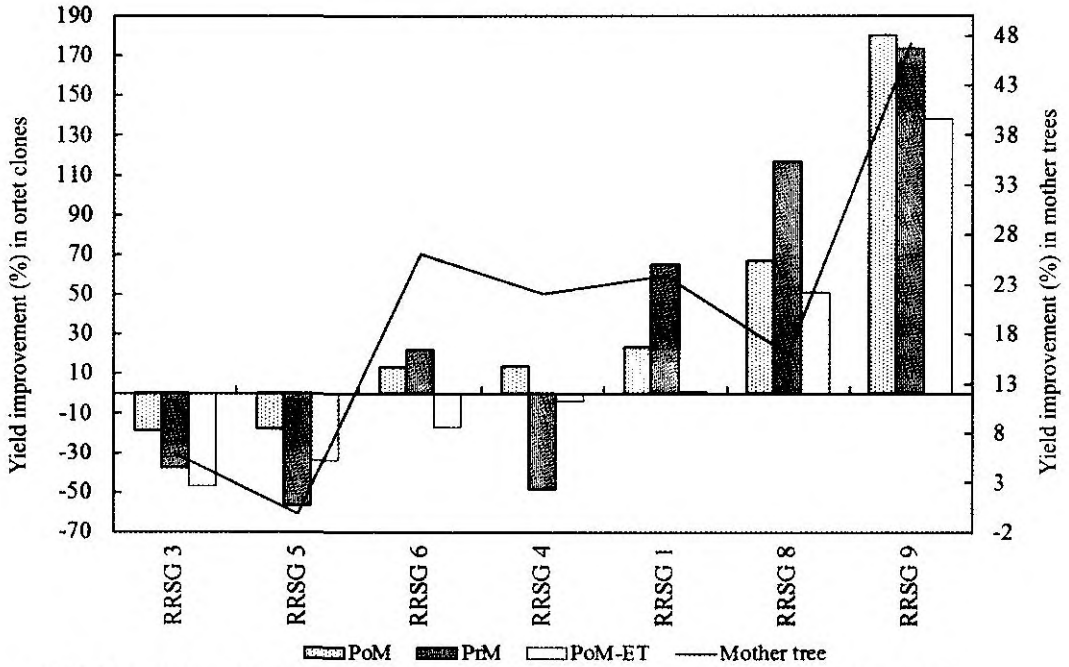
Table 2 .**Yield performance of ortets and juvenile yield of clones in nursery trial**

Ortet clones	Mean yield over 11 years (g tree^{-1} tap^{-1})	Juvenile yield in ortet clones (g tree^{-1} 10 tappings^{-1})			Juvenile yield efficiency (g cm^{-1} tree^{-1} tap^{-1})		
		During post- monsoon Period	During pre-monsoon period	Mean yield	During post- monsoon with 2.5 % ethephon	Without ethephon	With 2.5 % ethephon
RRSG 1	54.3 *	37.4	28.0	32.7	73.6	0.56	0.61
RRSG 3	46.4	24.6	10.5	17.6	38.3	0.32	0.35
RRSG 4	53.5	34.6	8.7	21.6	69.9	0.32	0.46
RRSG 5	43.7	24.8	7.3	16.1	48.1	0.24	0.38
RRSG 6	55.3	34.4	20.6	27.5	60.5	0.32	0.43
RRSG 8	50.8	50.8	36.7	43.8	109.8	0.54	0.73
RRSG 9	64.5 **	85.2 **	46.4 **	65.8 **	173.0 **	0.70 **	1.03 **
RRIM 600	43.8	30.4	17.0	23.7	72.7	0.4	0.6
CD (P ≥0.05)	8.46	22.5	15.3	18.0	47.6	0.17	0.24

* = Significant at 0.05 % level ** = Significant at 0.01 % level

RRSG 1, RRSG 4 and RRSG 6 than RRIM 600 but it was not so in the nursery trial. Deviation in yield of mother tree with its bud-grafted plant was also observed in Sri Lanka (Pathiratna *et al.*, 2007). In terms of juvenile yield efficiency of ortets RRSG 9 scored highest value with or without ethephon and was followed by RRSG 1 and RRSG 8.

Coefficient of variance (CV) among plants of each ortets was calculated and CV on girth at fifth year was lowest in RRSG 3 followed by RRSG 1 indicating less variation between plants (Table 3). In the case of girth increment, CV was as low as 4.9 per cent in RRSG 1 followed by RRSG 3. Juvenile yield with or without ethephon in all the ortets showed low CV in comparison to the general mean yield except RRSG 6 during post monsoon period which showed higher value and that in RRIM 600 and RRSG 5 where it was only 11.2 and 11.9 per cent, respectively. In RRSG 8, CV of mean juvenile yield was low without stimulation during pre-monsoon period and in RRSG 9 with stimulation it was the lowest. Yield improvement over control was highest in RRSG 9 in the mother tree as well as in nursery trial (Fig. 1). Among ortet clones, the second highest rank holder was RRSG 8, but the mother tree of this ortet did not show appreciable yield improvement. RRSG 1 showed considerable yield improvement during pre-monsoon period but during post monsoon with or without ethephon it was low. Performance, in terms of yield improvement of RRSG 3 and RRSG 5 was very poor. So far as yield is concerned, it is



PoM: Post monsoon; PrM: Pre monsoon; PoM-ET: Post monsoon with ethephon stimulation

Fig. 1. Yield improvement of mother tree and its ortets over RRIM 600

Table 3. **Coefficient of variance for growth and yield**

Ortet clones	CV of ortet clones (%)				
	Girth at 5th year	Girth increment at 5th year	Mean yield without ethephon		Mean yield with ethephon
			Post-monsoon	Pre-monsoon	
RRSG 1	12.9	4.9	27.7	49.4	25.7
RRSG 3	10.1	12.8	29.3	63.5	26.2
RRSG 4	27.1	32.1	20.2	60.9	49.5
RRSG 5	37.5	48.1	11.9	74.1	50.3
RRSG 6	22.1	37.8	49.6	52.7	41.1
RRSG 8	21.7	32.2	14.6	33.7	40.3
RRSG 9	15.2	27.9	13.6	42.6	23.2
RRIM 600	15.6	16.8	11.2	38.0	10.6

generally considered that under optimum growing conditions, a selection should be 30 per cent higher than the recommended clone (Rivano *et al.*, 2013). It was noted that the mother tree of RRSG 9 showed highest yield improvement (47.3%) over clone RRIM 600 under the agroclimate of Kamrup, Assam. The supremacy of RRSG 9 was continued to the nursery trial also.

Significant correlation between mother tree yield verses mean juvenile yield of ortets with or without ethephon, immature ortet girth verses juvenile yield and immature ortet girth verses juvenile yield with 2.5 per cent ethephon was observed (Table 4) indicating that the ortet clones in the present study maintained the character of their mother tree under budgrafted condition also. High correlation between early growth and juvenile yield in rubber was reported (Gonçalves *et al.*, 2004; Das *et al.*, 2009; Rao *et al.*, 2011; Mydin, 2012). Based on growth and yield, selection for best yielders may be evaluated (Varghese *et al.*, 1993) which would enable to reduce progeny size.

Mother tree selection from a large seedling population is a popular method of screening promising genotypes. From a base population of 49933 mother trees and of 88688 trees, raised from seeds from PBIG, Malaysia, eleven promising ortets from each sets of populations were selected on the basis of yield, growth and timber yield

Table 4. **Correlation between mother tree performance with ortet nursery performance**

Parameters	Correlation coefficient (r)
Mother tree yield over 11 years *vs* mean ortet clone juvenile yield	0.81**
Mother tree girth at 22nd years *vs* mean ortet clone juvenile yield	0.11
Mother tree yield over 11 years *vs* ortet clone girth at 5th year	0.07
Ortet girth at 5th year *vs* mean ortet clone juvenile yield	0.80**
Ortet girth at 5th year *vs* juvenile yield with 2.5% ethephon	0.85**
Mother tree girth at 22nd year *vs* juvenile yield with 2.5% ethephon	0.05
Mother tree yield over 11 years as juvenile yield with 2.5% ethephon	0.76*

* Significant at $P \geq 0.05$ ** Significant at $P \geq 0.01$

potential (Mydin *et al.*, 2005; John *et al.*, 2013). While aiming for screening ortet clones having high girth, high yield in the clonal nursery trial along with low CV and tolerance to cold stress during establishment stage in North East India, it was noted that RRSG 9 ensured all these potentials in the clonal nursery evaluation. It showed highest mean girth, girth increment with highest yield with or without ethephon and CV of less than 30 per cent in all these parameters compared to the check clone, RRIM 600. The mother tree of this ortet also showed appreciable girth and significantly higher yield than RRIM 600, with low CV (33.6%) for yield over 11 years of tapping. This was followed by RRSG 8 with appreciable girth, yield and yield improvement over the control. The performance of RRSG 1 was also noticeable with good pre-monsoon yield. These two promising ortet clones along with RRSG 1 could be recommended for next stage of large scale evaluation.

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REFERENCES

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.

Das, G., Mondal, G.C. and Chaudhuri, D. (2013). Adaptability of prospective mother trees of *Hevea* to the cold climate of Sub-Himalayan West Bengal and Assam. *Journal of Plantation Crops*, **41**(2): 163-71.

Gonçalves, P.S., Martins, A.L.M., Bortoletto, N. and Saes, L. (2004). Selection and genetic gains for juvenile traits in progenies of *Hevea* in São Paulo state, Brazil. *Genetics and Molecular Biology*, **27**(2): 207-214

Jacob, J., Othman, R., Mydin, K.K., Lam, L.V., Tuy, L.M., Woelan, S., Teerawatanasuk, K., Weiguo, L., Seneviratne, W.M.G., Omakhafe, K.O. and Mathurin, O.K. (2013). International clone exchange and genetic enhancement in *Hevea brasiliensis*. *Rubber Science*, **26**(1): 1-12.

John, A., Idiculla, M.A., Thomas, S.P. and Varghese, Y.A. (2013). Potential new primary clones of *Hevea* evolved by ortet selection in India. *Journal of Rubber Research*, **16**(2): 134-146.

Lloyd, D.G. and Schoen, D.J. (1992). Self and cross -fertilization in plants. I. Functional dimensions. *International Journal of Plant Science*, **153**(3): 358-369.

Mondal, G.C., Das, K., Chaudhuri, D. and Varghese, Y.A. (2006). Performance of ten selections from a polyclonal seedling block of natural rubber (*Hevea brasiliensis*) in Assam. *Journal of Plantation Crops*, **34**(3): 181-185.

Mydin, K.K., Licy, J., Varghese, Y.A., John, A., Nair, R.B. and Saraswathyamma, C.K. (2004). Clonal nursery evaluation for shortening the breeding cycle in *Hevea brasiliensis*. *Natural Rubber Research*, **17**(1): 60-66.

Mydin, K.K., John, A., Nazeer, M.A., Edwin Prem, E., Thomas, V. and Saraswathyamma, C.K. (2005). Promising *Hevea brasiliensis* clones evolved by ortet selection with emphasis on latex-timber traits and response to stimulation. *Journal of Plantation Crops*, **33**(1): 18-28.

Mydin, K.K. (2012). Juvenile-mature correlations and associations among rubber yield and yield attributes in *Hevea brasiliensis*. *Natural Rubber Research*, **25**(1): 1-12.

Mydin, K.K. (2014). Genetic improvement of *Hevea brasiliensis*: Sixty years of breeding efforts in India. *Rubber Science*, **27**(2): 153-181.

Nazeer, M.A., Licy, J., Mydin, K.K., Premakumari,

D. and Panikkar, A.O.N. (1993). Juvenile yield and growth attributes in some hybrid progenies of *Hevea brasiliensis* (*Willd. Ex Adr. De Juss.*) Muell.Arg. *Golden Jubilee Symposium on Horticultural Research – Changing scenario. Bangalore, May 1993.* pp.24-28.

Pathiratna, L.S.S., Wijesuriya, W. and Seneviratne, P. (2007). Comparison of yields between budgrafts and mother trees in *Hevea brasiliensis* Muell Arg. *Journal of Rubber Research Institute of Sri Lanka,* **88**: 47-58.

Rao, G.P., Madhavan, J. and Reghu, C.P. (2011). Further evaluation of selected wild *Hevea* germplasm accessions in India: 1. Performance in the immature phase. *Natural Rubber Research,* **24**(2): 211-219.

Rivano, F., Mattos, C.R.R., Cardoso, S.E.A., Martinez, M., Cevallos, V., Le Guene, V. and Garcia, D. (2013). Breeding *Hevea brasiliensis* for yield, growth and SALB resistance for high disease environments. *Industrial Crops and Products,* **44**: 659-670

Varghese, Y.A., John, A., Premakumari, D., Panikkar, A.O.N. and Sethuraj, M.R. (1993). Early evaluation in *Hevea*: growth and yield at the juvenile phase. *Indian Journal of Natural Rubber Research,* **6**(1&2): 19-23.