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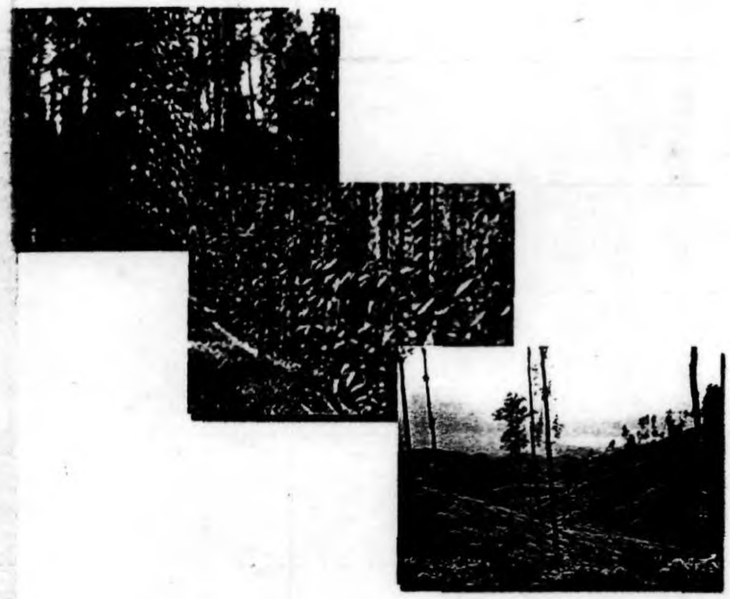

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Performance of some popular clones of rubber (*Hevea braziliensis*) and their hybrid progenies

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Abstract

Fourteen popular clones of rubber (Hevea brasiliensis Muell. Arg.) of varying origin and their hybrid progenies in eleven cross combinations were evaluated for girth, annual mean dry rubber yield and summer yield drop in the main field in a statistically laid out trial. The mean dry rubber yield in the first, second and third year of tapping, yield in the summer period of third year and girth at opening were analysed to identify superior parents and progenies. Significant variation was evident among the parents and hybrid progenies with respect to yield and girth. The mean yield of the parent clones over three years of tapping ranged from 15.01 to 67.33 g/tree/tap, while the mean yield of their hybrid progenies ranged from 15.05 to 45.87 g/tree/tap. The study revealed the high yield potential of clone PB 235 and the high vigour of RRII 118 and RRII 203.The drought tolerance potential of clones RRII 118 and PB 217 was also indicated from the present results. The cross combination RRII 105 x RRII 118 was superior for yield and girth with highest recovery of high yielding hybrids among the progeny.

Introduction

The para rubber tree (*Hevea brasiliensis* Willd.ex Adr.de Juss. Muell. Arg.), a native of Central America is the major source of natural rubber and it was domesticated after the invention of vulcanization by Charles Good Year. This perennial tree was introduced into South East Asia in 1876. The original rubber seedlings were reported to have an average yield of 200 to 300 kg per hectare per year (Panikker *et al.*, 1980). Now there are clones with a production potential of 3500 kg per hectare per year (Licy *et al.*, 1998). Conventional breeding techniques have played a major role in this productivity improvement. In India, rubber is cultivated in an area of 5.78 lakh hectares with a total annual production of 7.50 lakh tonnes. The productivity of rubber is 1705 kg per hectare per year. *Hevea brasiliensis* is a predominantly outbred species, which is amenable to vegetative propagation. Widespread use of clones as planting material has resulted in monoculture of the best clones and rubber plantations are thus rendered vulnerable to various maladies. To guard against the catastrophes, monoclonal plantation of rubber is now discouraged. Present day crop improvement programmes lay emphasis on evolving clones with a wider genetic base i.e. of varied parentage, and identification of the most potential parent which bears good characters to transfer to its progenies.

Materials and Method

A population of 700 mature trees consisting of 14 popular clones of *Hevea brasiliensis* of varying origin (Table 1) and their hybrid progenies in 11 cross combinations were planted in a simple lattice design with four replications and seven trees per plot at Central Experiment Station of Rubber Research Institute of India, situated at Chethackal, Ranni, Pathanamthitta dist, in Kerala. Each progeny constituted 28 individuals.

Tapping was initiated seven years after planting and the yield data of three consecutive years were recorded and statistically analysed. The yield of dry rubber per tree was recorded once a month on a normal tapping day by coagulating the latex in the collection cup and drying cup lumps in a smoke house. The weight of the dried cup lumps were recorded in grams per tree per tap, after discounting 10 percent of the weight to account for the residual moisture trapped in the cup lumps. The mean dry rubber yield of each parent and the progeny of each cross were worked out for each month. From the monthly mean yields, the mean yield over the year and the mean yield over three consecutive years were computed. The mean annual yield and the mean yield during the summer period (Feb-May) were computed separately for the third year of tapping when the yield in the first panel had stabilized. The extent of drop in yield in the summer months was computed as percentage over the annual mean yield. The girth of trees was recorded at a height of 150 cm from the bud union in the year of initiation of tapping.

Data on yield in the first, second, and the third year of tapping, yield in the summer period and girth at opening were subjected to the analysis of variance to identify the superior parents and progenies.

Results and Discussion

Tables 2 and 3 present the dry rubber yield of the parents and progenies respectively, for the first three years of tapping. There was highly significant variation among the parents and hybrid progenies with respect to yield.

Among the parent clones, PB 235 recorded the highest yield in the first year (76.95g/tree/tap), second year (49.94g/tree/tap) and third year(75.09g/tree/tap)of tapping. This clone was consistently superior to the high yielding check clone RRII 105, which gave a mean yield of 38.99 g/tree/tap over the first three years.

Among the 11 hybrid progenies evaluated, the progeny of the cross RRII 105 x RRII 118 was superior to the rest with a mean yield of 43.31, 36.87and 57.43 g/tree/tap in the first, second and third year of tapping respectively. This progeny showed a mean yield of 45.87g/tree/tap over the first three years, followed by the progeny of the cross RRII 105 x PB 86 (41.46 g/tree/tap), RRII 105 x PB 217 (36.96g/tree/tap)and PB 5/51 x RRII 208 (36.81 g/tree/tap). As shown in Figure 1, a high mean annual yield coupled with a high percentage recovery of high yielding clones within the progeny was recorded by the cross RRII 105x RRII 118.

The 14 popular *Hevea* clones included in the parentage of the hybrid progenies were studied with respect to the monthly variation in yield in the third year of tapping (Figure 2). All the clones in general showed a low yield during the summer period from February to May. There are ample reports that this drop in yield is due to the compounded effect of the dry summer period coupled with the stress on the rubber tree due to the process of refoliation taking place during the period. Clone PB 235 showed high yield throughout the year, with yield drop only in the February to May period. As evident from the graphs, clones PB 217, RRII 203 and RRII 118 maintained a higher level of yield compared to the rest of the clones in the summer period (February to May), indicating their tolerance to summer stress. In terms of absolute yield in the summer months, there was significant variation among the parent clones and progenies (Table 4) with the parent clones PB 235, RRII 203,PB 217 and RRII 118 maintaining comparatively high yields of 25.54, 24.31, 23.66 and 23.17 g/tree/tap respectively. In terms of extent of drop in yield in summer, among these clones, PB 217 and RRII 118 were found to be more tolerant to the summer stress with only 41.12 and 46.89 percent reduction respectively in yield from the annual mean yield level. Clone PB 86 also recorded a low yield drop of 42.14 percent in summer. These three clones, when crossed to RRII 105 produced progeny with a high mean yield in the summer months (Table 5). Among the three promising progenies (RRII 105 x RRII 118, RRII 105 x PB 217 and RRII 105 x PB 86), RRII 105 x RRII 118 established superiority in performance in summer, the progeny having recorded more than 22.79 g of dry rubber/tree/tap. The lowest mean yield drop in summer was recorded from the progeny of the cross RRII 105 x PB 217(40.69 percent), suggesting its tolerance to summer stress.

Clonal variation for girth at opening was also significant with the parent clones in general having recorded a mean girth of 47.82 cm(Table 6) and their hybrid progenies, 50.97 cm(Table 7).. Among the parent clones RRII 118 (59.41 cm), followed by RRII 203(57.72 cm) and PB 235 (56.82 cm) were the most vigourous, while RRII 105 recorded a girth of 49.98 cm in the year of opening. The progeny of the cross RRII 105 x RRII 118 recorded the highest girth at opening (56.31 cm), with 53.85 percent recovery of vigorous clones in the progeny. This was followed by the cross PB 5/51 x RRII 208 (53.75cm) and RRII 105 x PR 107(52.53cm) the latter showing a high recovery of 59.26 percent of vigourous hybrid clones.

Hevea brasiliensis being a perennial tree species, sustained high yield of rubber is of utmost importance, for which good tree growth is vital. Clone PB 235, in the present study has maintained high yield from the first to the third years of tapping as also reported earlier (Mydin, 1992). Clones RRII 118 and RRII 203 are reported to be very vigorous (Saraswathyamma *et al.*, 2000) and the present results corroborate the same. Clone RRII 105 is reported to possess high yield but average vigour while clone RRII 118 is a medium yielder with good vigor in terms of girth. The present study has revealed the superiority of the cross combination RRII 105 x RRII 118 in terms of annual mean yield, summer yield and girth. The prepotency of clone RRII 105 (Mydin *et al.*, 1996) may have contributed to the high recovery of high yielding clones within the progeny of this cross. The present results highlight the drought tolerance potential of clones PB 217 and RRII 118. This needs to be explored further since the progeny obtained on crossing these clones with RRII 105 also showed an inherent potential to maintain high yield in summer. Further evaluation of the high yielding hybrids and drought tolerant clones with in the progenies can help in developing superior clones with a wider genetic base.

Conclusion

The present study on 14 popular *Hevea* clones and 11 hybrid progenies with 28 clones per progeny has helped to establish the superior yielding ability of clone PB 235 and the high vigour of clones RRII 118 and RRII 203. The cross combination RRII 105 x RRII 118 was proved to be superior for yield and girth with a high recovery of high yielding hybrid clones within the progeny. The drought tolerance potential of clones PB 217 and RRII 118 and the scope for utilizing these clones in crosses with RRII 105 for evolving drought tolerant hybrids is also indicated from the present results.

Table 1: Parent clones used for hybridization

Clones	Country of origin
RRII 105	India
RRII 118	India
RRII 33	India
RRII 203	India
RRII 208	India
RRIM 600	Malaysia
PB 5/51	Malaysia
PB 28/59	Malaysia
PB 217	Malaysia
PB 235	Malaysia
PB 242	Malaysia
PB 86	Malaysia

Gl 1	Malaysia
PR 107	Indonesia

Table 2: Mean yield of parent clones over three years

Parent	Annual mean dry rubber yield (g/tree/tap)		Mean yield over three years	
	First year	Second year	Third year	(g/tree/tap)
RRII 105	44.92	31.72	40.33	38.99
RRII 118	36.21	33.23	42.60	37.35
RRII 33	17.83	14.51	18.40	16.91
RRII 203	44.08	44.90	57.45	48.81
RRII 208	28.66	25.73	32.37	28.92
RRIM 600	33.61	29.53	39.55	34.23
PB 5/5I	32.68	23.42	25.36	27.15
PB 28/59	46.60	35.36	46.62	42.86
PB 217	39.40	33.91	41.42	38.24
PB 235	76.95	49.94	75.09	67.33
PB 242	43.34	37.02	42.39	40.92
PB 86	33.12	24.85	25.22	27.73
Gl 1	17.79	17.97	26.34	20.70
PR 107	11.10	15.39	18.54	15.01
General mean	36.16	29.82	37.98	34.65
V.R	5.27**	6.51**	9.59**	11.66**
C.D.(0.05)	13.87	9.49	12.15	9.17

Table 3: Mean yield of progenies over three years

Progeny	Annual mean dry rubber yield (g/tree/tap)			Mean yield over three years (g/tree/tap)
	Firstyear	Second year	Third year	
RRII 105 x PB 5/51	37.49	25.84	35.99	33.11
RRII 105 x PR 107	41.40	26.79	33.21	33.80
RRII 105 x RRII 118	43.31	36.87	57.43	45.87
RRII 105 x PB 217	42.13	30.39	38.35	36.96
RRII 105 x PB 86	41.05	35.22	48.12	41.46
RRIM 600 x RRII 203	38.61	31.02	37.16	35.60
RRIM 600 x RRII 33	13.43	13.68	18.04	15.05
RRIM 600 x Gl 1	22.84	24.20	31.73	26.26
RRIM 600 x PB 235	33.41	25.97	37.65	32.34
PB 242 x RRII 105	36.55	24.86	33.36	31.59
PB 5/51 x RRII 208	35.87	31.29	43.26	36.81
General mean	33.10	29.82	37.66	33.53
V.R	5.27**	6.51**	9.59**	11.66**
C.D.(0.05)	13.87	9.49	12.15	9.17

Table 4: Yield performance of parent clones in summer (third year of tapping)

Clones	Dry rubber yield (g/tree/tap)	Summer yield drop (%)
RRII 105	13.93	65.00
RRII 118	23.17	46.89
RRII 33	5.78	58.39
RRII 203	24.31	58.78
RRII 208	16.75	48.29
RRIM 600	16.72	58.09
PB 5/51	9.39	63.61
PB 28/59	17.36	63.14
PB 217	23.66	41.12
PB 235	25.54	65.70
PB 242	19.76	54.26
PB 86	14.61	42.14
Gl 1	9.62	65.82
PR 107	6.97	59.91
General mean	16.26	56.51
V.R	5.22**	1.91*
C.D.(0.05)	7.15	18.28

Table 5: Yield performance of progenies in summer
(third year of tapping)

Progenies	Dry rubber yield(g/tree/tap)		Summer yield drop (%)
	Mean	% above mean	
RRII 105 x PB 5/51	11.03	40.91	68.26
RRII 105 x PR 107	14.90	43.48	52.34
RRII 105 x RRII 118	22.79	60.87	58.95
RRII 105 x PB 217	22.93	43.48	40.69
RRII 105 x PB 86	22.81	45.00	51.73
RRIM 600 x RRII 203	19.07	42.11	41.97
RRIM 600 x RRII 33	10.05	57.14	43.35
RRIM 600 x Gl 1	16.96	68.42	47.21
RRIM 600 x PB 235	14.18	40.00	61.06
PB 242 x RRII 105	16.58	28.57	51.18
PB 5/51 x RRII 208	21.16	47.83	49.01
General mean	17.50	40.07	51.43
V.R	5.22**		1.91*
C.D.(0.05)	7.15		18.28

Table 6: Girth of parent clones at opening

Clones	Girth at opening (cm)
RRII 105	49.98
RRII 118	59.41
RRII 33	37.76
RRII 203	57.72
RRII 208	50.46
RRIM 600	45.66
PB 5/51	45.84

PB 28/59	45.82
PB 217	47.77
PB 235	56.82
PB 242	44.44
PB 86	43.03
Gl 1	42.38
PR 107	42.41
General mean	47.82
V.R	4.09*
C.D.(0.05)	7.46

Table 7: Girth of progenies at opening

Progenies	Girth at opening(cm)	
	Mean girth(cm)	% above mean
RRII 105 x PB 5/51	49.98	50.00
RRII 105 x PR 107	52.53	59.26
RRII 105 x RRII 118	56.31	53.85
RRII 105 x PB 217	51.02	58.83
RRII 105 x PB 86	51.54	55.09
RRIM 600 x RRII 203	51.17	52.17
RRIM 600 x RRII 33	49.15	47.83
RRIM 600 x Gl 1	47.07	44.00
RRIM 600 x PB 235	47.83	60.87
PB 242 x RRII 105	50.28	40.90
PB 5/51 x RRII 208	53.75	45.83
General mean	50.97	51.69
V.R	4.09**	
C.D.(0.05)	7.46	

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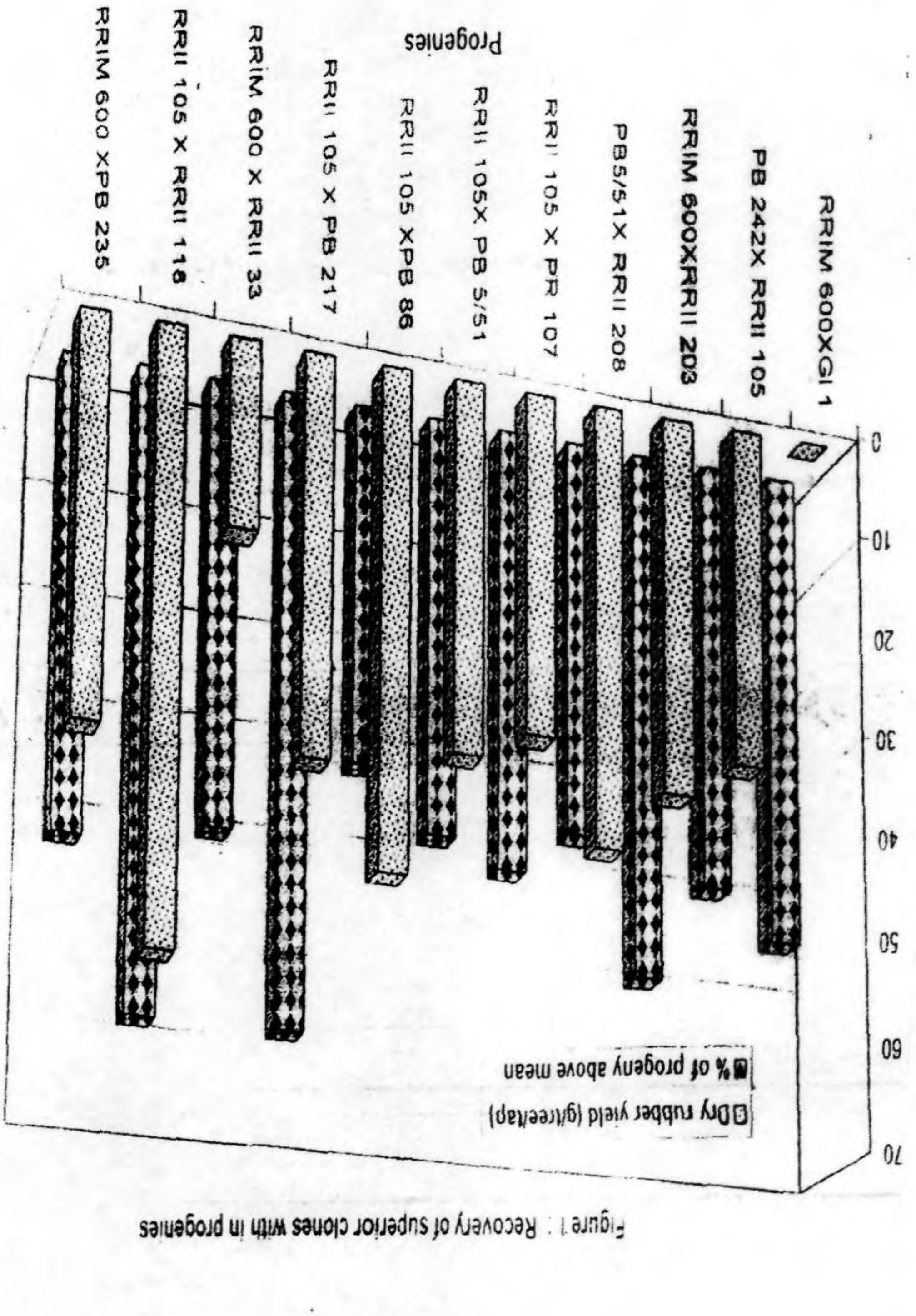

Figure 1 : Recovery of superior clones with in progenies

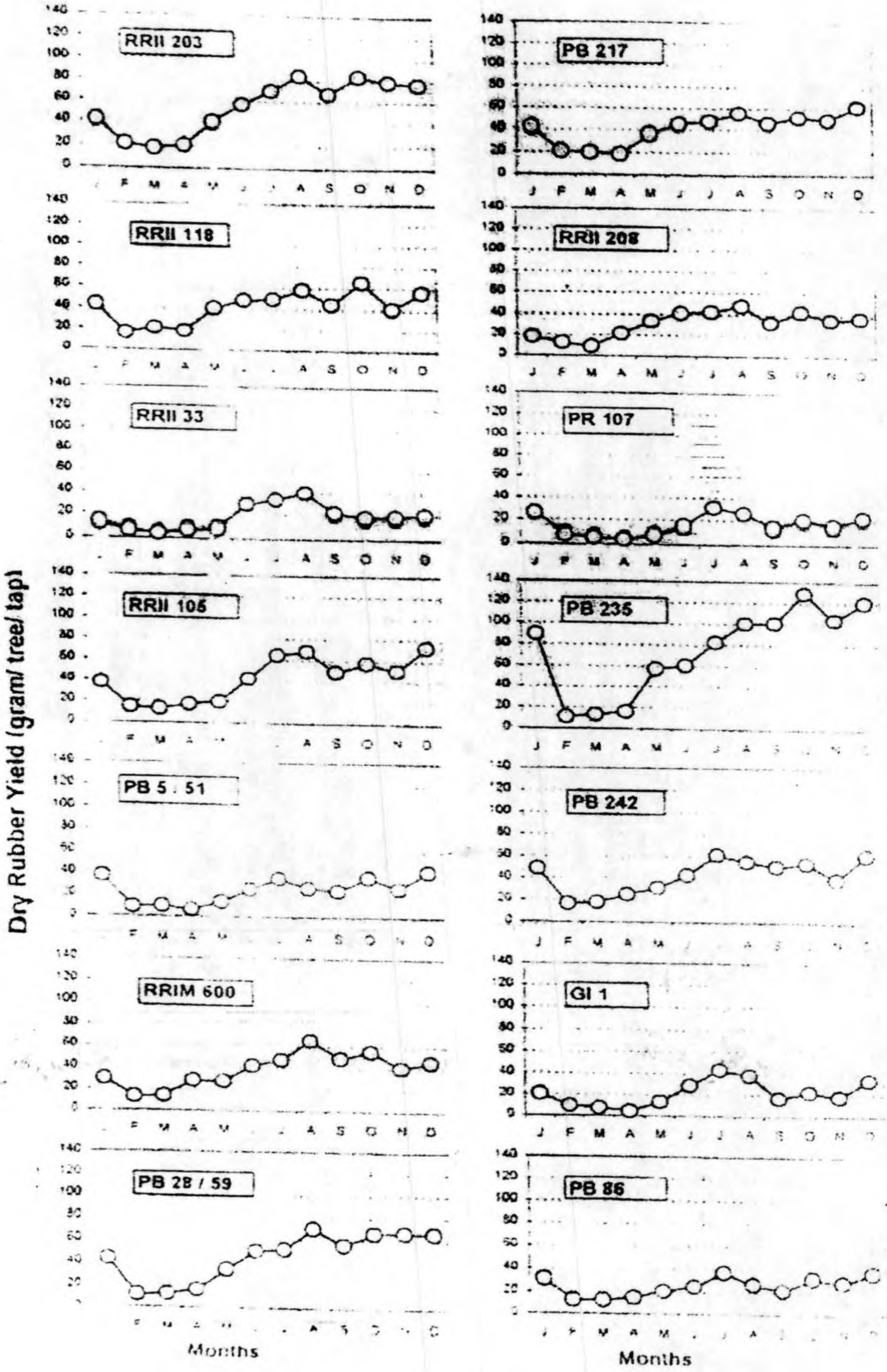

Figure 2 : Monthly variation in yield of parent clones

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