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HETEROSIS FOR JUVENILE VIGOUR IN *HEVEA BRASILIENSIS*

Hybridization followed by clonal selection in *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Muell. Arg. has yielded a number of promising clones. Fixation of heterosis is made possible by the well established vegetative propagation method. Olapade (1988) obtained very high estimates of heterosis for latex yield in certain hybrid progenies. Reports on the magnitude of heterosis for other yield attributes, however, are meagre.

In the present study, an attempt is made to determine the magnitude of heterosis for early vegetative growth of six hybrid clones (Table 1) as compared to their parents.

The clones were planted in a randomised block design with three replications at a spacing of 6 m x 3 m in plots of four plants each. Observations on plant height, number of flushes per plant, number of leaves per plant and girth at a height of 50 cm above the bud union were recorded when the plants attained 18 months' growth (Table 2).

Table 1. **Hybrid clones and their parentage**

Clones	Parentage
RRII 105	Tjir 1 x Gl 1
RRII 102	Tjir 1 x Gl 1
HP 55	Tjir 1 x Gl 1
HP 99	Fx 516 x Ch 31
HP 31	Tjir 1 x RRII 102
HP 35	Tjir 1 x RRII 102

Table 2. **Performance of parents and F_1 in early vegetative growth**

Clone	Plant height (cm)	Number of flushes per plant*	Number of leaves per plant*	Girth at 50 cm above bud union (cm)
Tjir 1	309.36	4.14	61.94	9.87
Gl 1	294.47	4.64	65.89	9.92
Fx 516	335.22	3.89	60.89	11.13
Ch 31	315.17	5.17	84.25	9.79
RRII 102	320.22	4.69	59.53	9.77
HP 55	331.97	3.81	51.06	11.05
HP 99	324.64	4.22	50.53	10.21
HP 31	371.08	6.14	99.78	11.63
HP 35	380.14	6.94	103.00	11.24
RRII 105	385.86	4.53	63.89	10.44
C. D. (P = 0.01)	115.46	1.24	28.70	2.48

* Significant.

Estimates of relative heterosis (heterosis over mid-parental value), heterobeltiosis (heterosis over the better parent) and standard heterosis (heterosis over the standard clone) were calculated as follows:

$$\text{Relative heterosis} = \frac{\bar{X}\,F_1 - MP}{MP} \times 100$$

$$\text{Heterobeltiosis} = \frac{\bar{X}F_1 - \bar{X}BP}{\bar{X}BP} \times 100$$

$$\text{Standard heterosis} = \frac{\bar{X}\,F_1 - \bar{X}\text{ std. clone}}{\bar{X}\text{ std. clone}} \times 100$$

where $\bar{X}\,F_1$ = Mean value of F_1

MP = Mid-parental value

$\bar{X}$ BP = Mean value of the better parent

$\bar{X}$ std. clone = Mean value of the standard clone, RRII 105

Heterosis was found to be manifested in all the four traits investigated though there was wide variation in its magnitude for these traits in different cross combinations. Five of the hybrid clones expressed positive relative heterosis and heterobeltiosis for plant height but only one clone, RRII 105, showed significant heterosis over mid-parental value. Four clones displayed positive heterosis for girth (Table 3). For the number of leaves per plant only two clones expressed positive heterosis and three clones displayed positive heterosis for the number of flushes (Table 4). Clone HP 99 expressed no heterosis for the vegetative characters studied.

Table 3. **Heterosis for plant height and girth**

Clone	Plant height					Girth					
	Relative heterosis		Heterobeltiosis		Standard heterosis	Relative heterosis		Heterobeltiosis		Standard heterosis	
	F_1–MP	%	F_1–BP	%		F_1–MP	%	F_1–BP	%	F_1–Std. clone	%
RRII 105	83.94	27.80*	76.50	24.73		0.54	5.45	0.52	5.24		
RRII 102	18.30	6.06	10.86	3.51	—	—	—	—	—	—	—
HP 55	30.05	9.95	22.61	7.31	—	1.15	11.62	1.13	11.45	0.61	5.84
HP 99	—	—	—	—	—	—	—	—	—	—	—
HP 31	56.29	17.88	50.86	15.88	—	1.81	18.43*	1.76	17.83*	1.19	11.40
HP 35	65.35	20.76	59.92	18.71	—	1.42	14.46*	1.37	13.88	0.80	7.66
CD (p = 0.05)	73.00		84.30			1.17		1.56		1.56	
CD (P = 0.01)	100.00					2.15		2.48			

* Significant at 5% level of probability.

Table 4. **Heterosis for foliar traits**

Clone	Number of flushes/plant						Number of leaves/plant					
	Relative heterosis		Heterobeltiosis		Standard heterosis		Relative heterosis		Heterobeltiosis		Standard heterosis	
	F_1–MP	%	F_1–BP	%	F_1–Std. clone	%	F_1–MP	%	F_1–BP	%	F_1–Std. clone	%
RRII 105	0.14	3.19	—	—			—	—	—	—		
RRII 102	0.30	6.83	0.05	1.08	0.16	3.53	—	—	—	—	—	—
HP 55	—	—	—	—	—	—	—	—	—	—	—	—
HP 99	—	—	—	—	—	—	—	—	—	—	—	—
HP 31	1.72	38.91**	1.45	30.92**	1.61	35.59**	39.04	64.27**	37.84	61.09**	35.89	56.17**
HP 35	2.52	57.01**	2.25	47.97**	2.41	53.20**	42.26	69.58**	41.06	66.29**	39.11	61.21**
CD (P = 0.05)	0.786		0.91		0.91		18.15		20.96		20.96	
CD (P = 0.01)	0.879		1.24		1.24		24.86		28.70		28.70	

** Significant at 1% level of probability.

The cross combination Tjir 1 x RRII 102 was found to be the most heterotic of the three crosses studied. Two clones, HP 31 and HP 35, of parentage Tjir 1 x RRII 102 showed vigorous growth as indicated by the highly significant heterosis over both mid-parental value and over the better parent for mean girth. Girth in *Hevea* is positively correlated with yield (Tan *et al.*, 1975; Simmonds, 1989) though not in all cases (Narayan *et al.*, 1974). Good immature vigour is one of the most important attributes associated with yield potential (Tan, 1987), juvenile girth having positive correlation with yield in the initial years of tapping (Premakumari *et al.*, 1989). Early opening and good early yield are only possible in a tree which grows very vigorously when young (Simmonds, 1989). Increased height, girth, number of flushes and leaves indicate vigour in the juvenile phase.

Analysis of variance revealed highly significant differences among clones for foliar traits, with HP 35 displaying the highest mean values of 6.94 and 103.00 for the number of flushes and number of leaves per plant, respectively. On comparison with clone RRII 105, which was the control, HP 31 and HP 35 showed significantly higher values for both the traits. Standard heterosis estimates for foliar traits of these two clones were highly significant (Table 4). "Useful heterosis" proposed by Meredith and Bridge (1972) on the basis of superiority over the best commercial variety is important in plant breeding.

The high heterosis estimates of HP 31 and HP 35 over their parents and over the standard clone RRII 105 for juvenile vegetative growth indicate potential for high yield.

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