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GENETIC PARAMETERS AND HETEROSIS IN RUBBER *(HEVEA BRASILIENSIS)* II. ASSOCIATION OF YIELD AND CERTAIN YIELD ATTRIBUTES

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ABSTRACT

Genetic parameters like coefficient of genetic variation, heritability, genetic advance and correlations were estimated for yield and certain biochemical yield components in nine clones of *Hevea brasiliensis* at 60 months' growth. Heritability was highest for magnesium content (H^2 82%) and lowest for TSC (H^2 42%). All characters except TSC showed high genetic advance. Yield revealed positive association with all other traits. The results indicate that biochemical yield attributes could also be used along with other yield attributes in tree improvement through hybridization as well as in early selection of hybrid clones.

INTRODUCTION

The heritable components of variation can be expressed in terms of genetic parameters like coefficient of genetic variation, heritability and genetic advance. Information on the degree and direction of association of yield with other traits as well as among the components would be of use in improving the efficiency of selection. The role and importance of biochemical yield components like Total Solid Content (TSC), Thiol, sucrose, inorganic phosphorus and magnesium in *Hevea* had been discussed by various workers (Jacob *et al.*, 1986; Eschbach *et al.*, 1984; Sherief and Sethuraj, 1978; Jacob *et al.*, 1983). The present study was undertaken to gather information on genetic parameters and associations for yield and five biochemical yield attributes in nine clones of *Hevea* and to ascertain their applicablility in tree improvement and early selection.

MATERIALS AND METHODS

The materials for the study comprised of seven hybrid clones belonging to 1982 HP series (HP 82/32, 82/33, 82/34, 82/59, 82/64, 82/68, 82/70), one popular hybrid clone (RRII 105) and a primary clone (PR 107) of *Hevea brasiliensis*. The plants were raised in the field during 1985 employing a randomized block design with three replications and four plants per replication. The plants were subjected to premature tapping at the age of 54 months. Latex samples of two plants each from each replication were collected in ice cooled beakers after six months of regular tapping. TSC, Thiols, inorganic phosphorus and magnesium were extracted from a known amount of latex with 2.5% trichloro-acetic acid. For the determination of TSC one gram of latex sample was dried to constant weight. Thiols were measured by the method of Boyne and Ellman (1972). Inorganic phosphorus was determined by the method of Taussky and Shorr (1953). magnesium was estimated by atomic absorption spectrophotometry method (Anonymous, 1973). The concentration of magnesium was obtained using atomic absorption spectrophotometer model No. GBC 902. The method of Scott and Melvin (1953) was followed for the estimation of sucrose. The procedure was repeated twice to confirm the results. Correlations and genetic parameters were worked out for the above characters using standard methods.

RESULTS AND DISCUSSION

Correlations

Correlation studies revealed the existence of positive association of latex yield with all traits studied (Table I) which suggested that increase in any one of them will lead to increased yield. Among the components, there were no negative correlations except for TSC with thiol and sucrose with inorganic phosphorus. Sucrose content of latex has been correlated positively with the amount of rubber produced in many cases (Tupy,

Table I. Simple correlation coefficients between yield attributes

Characters	Yield (X_1)	TSL (X_2)	Thiol (X_3)	Sucrose (X_4)	Inorganic phosphorus (X_5)	Magnesium (X_6)
Yield (X_1)	-	0.134	0.168**	0.318*	0.839**	0.515**
TSC (X_2)	-	-	-0.092	0.270*	0.449**	0.156
Thiol (X_3)	-	-	-	0.645**	0.686**	0.742**
Sucrose (X_4)	-	-	-	-	*-0.009*	*0.195*
Inorganic phosphorus (X_5)	-	-	-	-	0.342**	0.342

* Significant at 5% level ** Significant at 1% level

1973, Eschbach *et al.*, 1984)). A high value of inorganic phosphorus shows that the laticiferous system is very active (Lynen, 1969). Thiols present in latex are able to neutralize toxic oxygen produced during cell metabolism. In addition, thiols can activate some key enzymes, increasing metabolic activity and hence the regeneration of latex (Jacob *et al.*, 1986). Magnesium content in latex is also known to activate some key enzymes (D'Auzac, 1975), governing metabolic activity.

Genotypic and phenotypic correlations followed the same trend and in general the genotypic correlations were higher than phenotypic correlations (Table II). Yield was strongly and positively correlated with thiols, inorganic phosphorus and magnesium content both at genotypic and phenotypic levels. Similarly, thiol content also exhibited strong positive association with sucrose, inorganic phosphorus and magnesium both at genotypic and phenotypic levels. At both levels, sucrose exibited positive association with inorganic phosphorus and magnesium. So was the association between inorganic phosphorus and magnesium.

From the above, it was observed that rubber yield, thiols, inorganic phosphorus and magnesium were positively inter-correlated. Hence, increasing any one character may result in simultaneous increase in other characters resulting in increased yield.

Genetic parameters

Analysis of variance revealed significant variation for all the characters studied in the premature phase of tapping. Inorganic phosphorus exhibited the highest range of variability (561.30-5304.23/µg/g) whereas sucrose exhibited the lowest range (6.61-13.95/µg/g). Genetic parameters for yield and the traits under study revealed high values of genotypic as well as phenotypic coefficients of variation for inorganic phosphorus content (GCV 74.13 and PCV 85.16) followed by high GA over mean (133). Total Solid Content showed the lowest values of GCV (7.05) and PCV (10.91), coupled with the lowest values of heritability (42%) and genetic advance (9%).

Heritability was highest for Magnesium content (H^2 82%) (Table III). Except TSC all characters exhibited medium to high value of GCV, PCV, heritability and genetic advance which indicates that selection based on these characters

Table II. Genotypic (upper diagonal) and phenotypic (lower diagonal) correlation coefficients among yield and yield attributes

Characters	*Yield*	*TSL*	*Thiol*	*Sucrose*	*Inorganic phosphorus*	*Magnesium*
Yield	1	-1.13	0.737	0.537	1.035	0.796
TSC	-0.711	1	-0.844	-0.679	-1.15	-0.918
Thiol (X_3)	0.686	-0.719	-	0.813	0.813	0.929
Sucrose (X_4)	0.392	-0.742	0.718	1	0.601	0.554
Inorganic phosphorus	0.903	-0.785	0.718	0.554	1	0.866
Magnesium	0.601	-0.739	0.775	0.644	0.734	1

Table III. Range and mean of genetic parameters for yield and yield attributes

Characters	Range	Mean	Coefficient of variation		Heritability (H^2 %)	GA (% over mean)
			Genotypic	Phenotypic		
Yield g / tree / tap	6.67-49.61	20.06	63.82	78.74	65.69	107.06
TSC (g%)	37.58-48.14	44.73	7.05	10.91	41.74	9.21
Thiol (µg/g)	29.43-204.15	104.68	48.52	60.85	63.60	78.96
Sucrose(µg/g)	6.61-13.95	9.96	21.53	28.17	58.0	33.65
Inorganic Phosphorus(µg/g)	561.30-5304.23	2025.92	74.13	85.16	76.00	133.00
Manganesium(µg/g)	137.38-2147.87	984.49	63.08	69.84	81.5	118.18

would be advantageous since there is the predominance of additive gene action in the expression of these characters (Table III).

Henon *et al.*, (1984) have suggested detection of biochemical factors to provide information about yield potential at immature stage. Identification of biochemical differences between clones at a young stage may be useful in early detection of yield characteristics. The present study indicates that content of thiols, magnesium and inorganic phosphorus in latex could be of use to a great extent for early detection and selection of likely potential clones where as TSC and sucrose could not be relied upon *per se*.

Yield being a quantitative character no single factor could be attributed to production. However, a cumulative effect of all yield contributing factors have to be considered for prediction of yield.

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DISCUSSION

P.R.V. SUBRAMANIYA IYER : Your plot size is only 4 trees. Is your study valid considering the small plot size of only four trees? You mentioned about Mg. What is your conclusion based on your study?

J. LICY : The experiment is a small scale trial. For biochemical analysis of late samples, this plot size is found to be enough. However, this will be analysed in large scale trial too. Our study indicates that Mg activates the key enzymes involved in latex production increasing yield.

K. MURALEEDHARAN : GCV (genetic coefft. of variation) is not a genetic paramenter. H^2, obtained is heritability in broad sense - Not having much use in any index.

J. LICY : The title of the table will be suitably changed as range, mean, coefficient of variation and genetic parameters. A delegate only suggested to formulate a selection index and we can as well estimate heritability in narrow sense so that index can be formulated.

C.S. SRINIVASAN : I think the biochemical parameters should be compared with a selection index rather than estimating genetic advance for individual parameters.

J. LICY : The suggestion is taken care of for which we will estimate heritability in the narrow sense too which will be much useful.

S. SHIVASHANKAR : I would like to know if you have followed the same seedlings from the nursery upto the bearing stage in order to establish the correlation between early growth and yield?

J. LICY : All the studies were confined to clones - not seedlings. The same trees of the clones under study were studied in the juvenile, premature stages and will be evaluated in the mature phase too.

A.K. SADANANDAN : Methodology for Mg adopted was stated as IRRI 1973. Kindly enlighten the details?

J. LICY : The methodology for Mg followed is as per RRIM 1973 - not IRRI. Please refer to the list of references in the paper.

D.P. VERMA : Why potassium was not included in biochemical paramaters in evaluation? In future study, K may be included along with P and Mg.

J. LICY : In future studies K will also be analysed.