SUMMARY

Genetic studies on yield and certain yield components in *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Muell. Arg. were undertaken with respect to twelve exotic and one indigenous clone. The objectives of the present study were to assess the genetic variability for yield and yield components and evaluate the performance of clones in the local agroclimatic condition in comparison to RRII 105, the outstanding high yielder. The study also envisages to examine the major factors contributing to yield and identifying genetically divergent genotypes as well as prepotent clones. Biochemical and molecular approaches for assessment of genetic variability was also attempted. Observation were recorded for three consecutive years from 1998 - 2001 and data analysis was carried out separately for annual mean, peak yielding season (October - January) and stress (summer) period (February - May).

The highest annual mean dry rubber yield was estimated for the clone PB 255 (73.52 g t⁻¹ t⁻¹) and lowest for PB 217 (38.17 g t⁻¹ t⁻¹). Yield of seven clones viz., PB 255 (73.52 g t⁻¹ t⁻¹), PB 314 (66.88 g t⁻¹ t⁻¹), PB 280 (66.81 g t⁻¹ t⁻¹), PB 260 (63.20 g t⁻¹ t⁻¹), KRS 163 (62.96 g t⁻¹ t⁻¹), PB 312 (62.13 g t⁻¹ t⁻¹) and PB 311 (60.33 g t⁻¹ t⁻¹) was significantly superior to RRII 105 (49.50 g t⁻¹ t⁻¹). Significant difference in yield was noted among clones during different seasons also. The yield depression estimated was minimum for PB 255 (27.99 %) while the clone PB 235 (49.87 %) recorded the highest yield depression during stress. This showed the consistency of the clone PB 255, in yield potential during the entire period of the year.
Based on the performance of high yield and bole girth four clones viz., PB 255, PB 280, PB 312 and PB 314 were identified as latex-timber clones.

Highly significant clonal variations were recorded for all the yield components studied. Wide range of variations were recorded for girth at opening (50.96 to 61.33 cm.), annual dry rubber yield (38.17 to 73.52 g t\(^{-1}\) t\(^{-1}\)), rubber yield in stress season (26.29 to 52.74 g t\(^{-1}\) t\(^{-1}\)) and peak season (44.75 to 80.42 g t\(^{-1}\) t\(^{-1}\)), yield depression during stress (27.99 to 49.87 %), latex yield (107.60 ml t\(^{-1}\) t\(^{-1}\) to 176.85 ml t\(^{-1}\) t\(^{-1}\)), latex yield during stress (58.31 ml t\(^{-1}\) t\(^{-1}\) to 115.26 ml t\(^{-1}\) t\(^{-1}\)) and peak season (117.27 ml t\(^{-1}\) t\(^{-1}\) to 193.17 ml t\(^{-1}\) t\(^{-1}\)), latex vessel rows in virgin (16.68 to 28.64) and renewed bark (14.20 to 30.96). However, low range was recorded for girth increment, rubber content, in different seasons and also for bark thickness.

Phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters studied. However, it was closer for most of the characters, which implies the lesser influence of environment in the expression of these characters. High PCV and GCV was estimated for annual mean dry rubber yield, rubber yield in stress and peak seasons, yield depression, latex yield during stress season and latex vessel rows in renewed bark. High genetic advance coupled with high heritability was recorded for yield depression, rubber yield in stress period, latex yield during stress period and rubber yield during peak season.

Among the 23 characters studied, most of the correlations were found to be in positive direction. At both phenotypic and genotypic levels rubber yield during stress and peak period, annual latex yield, latex yield in stress and peak season, latex vessel rows in renewed bark exhibited high and positive association with annual dry yield. However, annual plugging index (PI), PI during stress and peak periods was low and negative with
annual dry yield. The high positive association implies the scope for simultaneous improvement of these traits by selection that in turn will improve yield as well.

Performance of the 13 clones based on the pooled data of yield and major yield components showed that PB 280 was ranked first followed by PB 255 and KRS 128. The Indian clone RRII 105 ranked fourth among the clones studied. Hence it is noted that in general, high yielders recorded higher values for these traits in comparison with medium and low yielders.

D² analysis based on yield and major yield components viz., girth, dry rubber content, latex yield, plugging index, bark thickness and number of latex vessel rows showed that the cultivars were grouped into two major clusters. The inter cluster distance was 78.11. The intracluster distance in cluster I was 24.65 while that of cluster II was 34.14. The D² value ranged from 1.79 to 159.55 showing considerable genetic variability existing in the population. The highest genetic distance was recorded between PB 312 and PB 280 (159.55) and the lowest was between PB 260 and KRS 163 (1.79).

The present study also envisages isozyme and random amplified polymorphic DNA (RAPD) marker analysis to determine genetic variability and relatedness in a set of cultivated Hevea clones and to select genetically divergent genotypes for setting up hybridization aimed at achieving high heterosis for yield and vigour in progenies. Out of the nine isozyme systems studied, a total of four viz., aryl esterase, peroxidase, aspartate aminotransferase and shikimate dehydrogenase showed polymorphism. A combined total of 22 isozyme bands were scorable and a mean of 15 bands per clone was observed. The number of bands in different clones ranged from 11 to 19. Isozyme analysis clearly distinguished all the 13 clones from one another.
Genetic studies using DNA based molecular markers are limited in *Hevea brasiliensis*. In the present study 55.80 per cent of the RAPD were polymorphic among the 13 cultivated clones of *Hevea* based on RAPD. The genetic polymorphism was found to be reasonably good according to the earlier reports. Among the different clones tested PB 255 displayed the maximum average genetic distance followed by KRS 163, KRS 128 and PB 314. Genetic distance estimated by RAPD markers reveals that there are three major groups among the 13 clones.

A comparative analysis of genetic distance estimated markers reveals that DNA based RAPD markers are more reliable than that of isozymes as there are limitation in utilising them are genetic markers. Genetic distance based on $D^2$ analysis revealed that all the clones were clustered irrespective of their country of origin. However, in RAPD 13 clones were grouped into three clusters as they originated from three different countries. In some cases clones were clustered together, perhaps it may be due to their common parentage in their ancestry.

Important properties that related to latex and rubber qualities for the 13 clones showed significant clonal variation.

To identify genetically superior mother parents for the production of quality seeds in seed gardens, progeny analysis was carried out. Correlation among juvenile characters elucidated highly significant positive association. The open pollinated progenies of PB 255, PB 260, PB 310, PB 311, PB 312, PB 314 and RR1105 recorded more percentage of seedling showing above mean progeny yield ($4.14 \text{ g plant}^{-1} \times 10^{-1}$). The progenies of PB 255 recorded the highest percentage (68.00 %) and KRS 25 exhibited the lowest (29.58 %). Of the 13 clones evaluated, these seven clones were identified as likely prepotents with high performance
index value based on juvenile characters i.e., yield, girth, height and number of whorls. High proportion of superior seedlings was recovered based on juvenile yield. The high performance index and high percentage of superior seedlings are the indication of the ability of a parent to transmit superior traits to its offspring.

Based on the performance of clones at different stages of evaluation with respect to yield and secondary characters they are being included in different categories of planting materials recommended for growers. Clones included in category I are those approved for large scale planting. Merits and demerits of these clones are studied thoroughly. Category II comprises clones, which are suitable for moderate scale planting. Category III clones are recommended only for experimental planting in a limited scale. In the present study, PB 255, PB 260, PB 280, PB 312, PB 314 and KRS 163 are comparatively superior to RRII 105 with respect to yield. Since a single clone-RRII 105 occupies the major portion of rubber growing area, these clones can be used for multiclone planting. The clones having high yield and vigour can be considered as latex - timber clones. PB 255, PB 280, PB 312 and PB 314 possess both high yield and vigour. The output of timber from vigourous clone is comparatively more.

The results of present investigations show that genetic variation exist in the population and selection based on these characters can provide better genotypes for further breeding programmes. Among the 13 clones studied, 7 clones (PB 255, PB 260, PB 280, PB 311, PB 312, PB 314 and KRS 163) recorded significantly higher yield than RRII 105. These clones hold promise for further planting in growers sector.