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ESTIMATES OF VARIABILITY AND ASSOCIATIONS OF CHARACTERS OF ROOT STOCK SEEDS AND RESULTANT SEEDLINGS AND COMPARISON OF SEED TYPES IN RUBBER

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The use of assorted seeds to develop root stock material for budgrafting in rubber produces highly heterogeneous stock seedlings, which can interact with the scion to generate variability at different levels. This study was conducted to estimate the variability and associations of certain quantitative traits of root stock seeds, seed germination and juvenile growth attributes of resultant seedlings. The assorted seeds have been compared with three different monoclonal seed types for these characters. Low magnitude of variability, within group, was recorded for all the characters under study in monoclonal seeds, while though assorted seeds showed comparatively higher value. The seed characters and germination percentage recorded high heritability, in the broad sense, while for the juvenile growth attributes it was low. The seed types showed significant differences for the various traits studied. Germination percentage was the most reliable criterion for seed viability and seedling growth. Root / shoot ratio was more influenced by the shoot biomass than the root biomass. The results of this study confirm the validity of assorted seeds as the best material for raising stock seedlings. For further improvement of the quality of root stock seeds collected from Kanyakumari region, it is suggested to avoid mixing with the seeds of the clone PB 28/59.

Key words : Budding, Germination, *Hevea brasiliensis*, Root stock, Rubber, Seed, Variability.

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INTRODUCTION

The para rubber tree (*Hevea brasiliensis*) is propagated by budgrafting. The accepted nursery practice to develop root stock material is the use of assorted seeds, considering the convenience in handling and their easy availability as commercial seeds. This results in production of highly heterogeneous stock seedlings. Some variations of metric characters among the trees of clonal populations (Buttery, 1961; Alika, 1980; Chandrasekhar *et al.*, 1997) have been reported. The genetic basis of such variations has not been investigated since the scion part of all trees of a clone is genetically uniform. There are some reports to show intraclonal variations in *Hevea* at enzyme level (Krishnakumar *et al.*, 1992; Sobhana *et al.*, 2000). Such variations can be the expressions of stock-scion interaction and hence the genetic variability of root stock sources, which can interact with the scion to generate variability at different levels, gains importance. As a preparatory part of a detailed investigation on the intraclonal variations and associations in RRII 105, the most popular clone in India, this study was conducted to estimate the variability and associations of certain quantitative traits of root stock seeds, seed germination and juvenile growth attributes of resultant seedlings. Such information is very useful for the refinement of nursery practices also.

The assorted seeds have been compared with three different monoclonal seed types for the characters studied.

MATERIALS AND METHODS

During the 1999 seed fall season (June-July) 1000 seeds each of four seed types were collected from Kanyakumari region. Type 1 was the commercial seeds, which was a mixture of locally available seeds, termed as assorted seeds. This is being conventionally used in rubber nurseries. Type 2, 3 and 4 were monoclonal seeds of RRII 105, RRIM 600 and PB 28/59 respectively, collected from the central part of large monoclonal areas planted with the respective clones. These three clones are widely planted in Kanyakumari region. The seeds of each seed type were mixed thoroughly and divided into five lots to serve as five replications. Seed weight and seed volume were recorded from 40 seeds per replication. Each seed was weighed accurately using an electronic balance and volume was taken by displacement method.

The seeds were put out for germination in a CRD layout with five replications and 200 seeds per pot. Germination beds were prepared following standard methods. Germinated seeds were transplanted to a seedling nursery of the same design with a net plot size of 160 seedlings in each replication.

Plant height and dry weights of root and shoot were recorded two months after the first day of germination. For recording the dry weight of root and shoot, five plants per replication were pulled out, washed well with water and dried in an oven and weighed. The data was analysed statistically for variability and associations.

RESULTS AND DISCUSSION

The coefficients of variation for seed weight and seed volume are given in Table 1. The assorted seeds recorded higher CV for both the characters when compared to the monoclonal seed types indicating the uniformity of the monoclonal seeds. But the CV values recorded for assorted seeds are only 20.423 and 20.435 respectively for the two characters which imply that the heterogeneity of commercial seeds, now available in Kanyakumari region is not high probably due to the low number of clones grown in these plantations.

Table 1. **Coefficient of variation for seed weight and seed volume**

Seed type	Seed weight	Seed volume
Assorted	20.423	20.435
RRII 105	10.156	17.181
RRIM 600	11.099	13.492
PB 28/59	12.199	12.323

Variability parameters for the characters under study are shown in Table 2. The variance ratio for all the three seed characters are highly significant. The values of genotypic and phenotypic coefficients of variations show that variation for seed volume, seed weight and germination percentage have high genetic involvement and those characters are highly heritable. For none of the growth characters variance ratio was significant. Significant difference in growth among seedlings raised from

Table 2. **Variability for seed and vegetative characters of young seedlings**

Character	G Mean	MS	VR		GCV	PCV	H2 (%)
Seed volume	7.54 cm^3	2.7445	28.60	**	9.653	10.491	84.657
Seed weight	4.79 g	1.6345	171.71	**	11.903	12.070	97.25
Germination	69.50 %	1271.80	31.13	**	22.576	24.377	85.769
Root weight	17.25 g	0.5673	0.17	NS	-	-	-
Shoot weight	26.06 g	2.0293	0.44	NS	-	-	-
Root/shoot ratio	0.68	0.0084	1.54	NS	-	-	-
Plant height	24.51 cm	5.8945	2.92	NS	-	-	-

** $P<0.01$

Table 3. **Comparison of seed types for seed and plant characters**

Seed type	Seed volume (cm3)	Seed weight(g)	Germination (%)	Root weight (g)	Shoot weight(g)	Root/ shoot ratio	Plant height (cm)
Assorted	7.47	4.73	72.20	17.52	25.60	0.72	23.7
RRII 105	8.58	5.50	80.40	16.76	27.00	0.63	24.98
RRIM 600	6.85	4.25	79.20	17.40	25.88	0.68	25.82
PB 28/59	7.26	4.58	46.20	17.32	25.76	0.71	23.54
SE	0.14	0.04	2.86	0.82	0.96	0.03	0.64
CD P≤0.05	0.42	0.13	8.57	–	–	–	–

monoclonal seeds of a few clones have been reported earlier (Saraswathyamma *et al.*, 1984). In this study the seedlings observed were younger and more observation before budgrafting is needed to draw conclusions.

Table 3 depicts the comparative values of assorted and monoclonal seed types with respect to the seed characters, germination and growth characters. The seed volume and seed weight of RRII 105 was higher than the other two clones and assorted seeds. RRIM 600 recorded the lowest values for both the traits. Seeds of RRII 105 and assorted seeds were on par and recorded higher values for germination percentage. Germination percentage was the lowest for the seeds of PB 28/59. This is a very popular clone in Kanyakumari region (Alexander, 1987; Mercykutty *et al.*, 1995) and there is good chance of the seeds of this clone mixing with the lots of commercial seeds coming from that region. Since the viability of rubber seed, after seed maturity is short (Dijkman, 1951; Premakumari, 1975) under normal conditions, delayed seed fall reduces germination percentage. *Odium* infection is another factor, which affects seed viability. This disease is very prevalent in Kanyakumari region (Jacob *et al.*, 1992) and PB 28/59 is highly susceptible to it (Saraswathyamma *et al.*, 2000). The results of the present study indicate the possibility of improving the viability of commercial seeds from Kanyakumari by discarding the seeds of this particular clone from the seed lots to be used for raising seedling nurseries.

Assorted seeds recorded better values than the monoclonal seed types for root weight and root/shoot ratio. A strong and healthy root system with good root/shoot ratio is a priority for grafted plants, especially in the case of *Hevea* for which uprooting is a problem. The above observations confirm the validity of assorted seeds as the best material among the seed types studied. Shoot weight was the highest for RRII 105 along with a low root/shoot ratio, in terms of dry weight.

The associations among seed characters, germination and growth characters are shown in Table 4. Seed volume versus seed weight showed high and significant positive correlation. The relationship of both the characters with germination percentage and shoot weight were positive but were not significant. Plant height did not show any

Table 4. **Correlations among seed and plant characters**

Character	r-value	Character	r-value	Character	r-value
X1 X2	0.9243 **	X2 X4	-0.1426 NS	X3 X7	0.5123 *
X1 X3	0.2803 NS	X2 X5	0.2983 NS	X4 X5	0.3507 NS
X1 X4	-0.1766 NS	X2 X6	-0.3776 NS	X4 X6	0.4561 *
X1 X5	0.2385 NS	X2 X7	0.0101 NS	X4 X7	0.0549 NS
X1 X6	-0.2973 NS	X3 X4	0.0077 NS	X5 X6	-0.6015 **
X1 X7	0.0040 NS	X3 X5	0.2085 NS	X5 X7	0.2807 NS
X1 X3	0.3021 NS	X3 X6	-0.3136 NS	X6 X7	-0.3668 NS

* P<0.05; ** P<0.01; X1 - Seed volume; X2 - Seed weight; X3 - Germination percentage; X4 - Dry weight of root; X5 - Dry weight of shoot; X6 - Root/Shoot ratio; X7 - Plant height

relationship with the quantitative traits of seeds. The influence of seed weight on seedling vigour in rubber, at the nursery stage, has been reported earlier (Saraswathyamma and Nair. 1976) but that relationship was not retained at maturity. In the present study no such association was observed. Moreover, the relationship of seed volume and seed weight indicated a negative relationship with root weight as well as with root/shoot ratio. This is not a desirable trend and hence seed selection based on weight or volume, for nursery purpose, cannot be suggested. Seed germination showed significant positive association with plant height indicating good growth potential. The above results show that seed germination is the best indicative criterion for seed viability and good seedling growth. The correlations among root weight, shoot weight and root/shoot ratio showed that the root/shoot ratio is more influenced by the shoot biomass than the root biomass. The association between dry weight of shoot and plant height was not statistically significant indicating the contributions of some other characters also for shoot biomass.

CONCLUSION

The monoclonal seeds showed more uniformity than the commercial seeds for seed weight and seed volume as expected. The heterogeneity of commercial (assorted) seeds collected from Kanyakumari was not very high. For the expression of seed weight, seed volume and germination percentage genetic involvement is very high. The seed types under study showed significant differences for the seed characters and germination percentage. Seed volume or weight cannot be taken as reliable criterion for seed selection for nursery purpose. Seed germination is the best indicator of viability and good seedling growth. RRII 105 is a good seed source as far as seed viability is concerned and PB 28/59 is inferior to RRII 105, RRIM 600 and assorted seeds. In the present situation there is no harm in using the commercial seeds available at Kanyakumari for raising stock seedlings. But omission of the seeds of PB 28/59 may further improve the quality of commercial seeds to be used in the nursery. The variations among the assorted and monoclonal seed types for seedling biomass production or plant height at juvenile stage did not show any significant differences.

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