Research Article

doi: 10.25081/jpc.2022.v50.i3.7881
Journal of Plantation Crops, 2022, 50(3): 125-128

Clonal variations in seed characters and germination in *Hevea brasiliensis*

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(Manuscript Received: 29-07-22, Revised:19-10-22, Accepted:25-10-22)

Abstract

The principal form of dissemination for most plant species is seeds, an important source of biodiversity conservation. For rubber plantations, seeds are the initial material for seedling production. In Cameroon, there is limited information related to clonal seed characterisation and early growth performance. This study sorts to characterise *Hevea brasiliensis* seeds from GT 1, PR 107, PB 217, PB 235, and PB 260 clones and evaluate the germination rate and seedling early growth characteristics to enable planning for nursery management. Clone GT 1 had the highest seed length (3.98 cm), seed kernel weight (3.4 g) and total seed weight (4.75 g). Clone PB 235 had the heaviest shell (1.96 g). There was no significant correlation between seed size, germination percentage and early seedling growth for the different clones. Clone PR 107 had the lowest per cent seed germination, with just 55 per cent of its seed germinating after two weeks, whereas clone PB 217 had the highest seed germination (92.5%). Seedling height, seed germination percentage and shell weight were significantly correlated. The results of this study provide some useful information for rubber nursery managers.

Keywords: Clones, germination rate, *Hevea brasiliensis*, seed characters

Introduction

The rubber tree (*Hevea brasiliensis* Muell. Arg.) is the main source of natural rubber and grows well in hot, humid climates. When properly managed, rubber trees get into tapping in 5 to 6 years and can be harvested for rubber latex for up to 30 years. Each fruit of a rubber tree has about four seeds which are dispersed by an explosive mechanism on drying (Nwokolo, 1996). About 800-1200 kg ha^{-1} year^{-1} of rubber seed is expected to be produced, considering the fact that each tree yields about 800 seeds (1.3 kg) year^{-1} (Siriwardene and Nugara, 1972).

Seeds are the main form of dissemination and are responsible for the conservation of biodiversity (Marcos, 2005). The pathway from adult to offspring is through seed germination, making it an important stage in the life history of plants (Xu *et al*., 2014). Seed size is an important characteristic of seed quality because larger seeds contain more resources and are likely to exhibit greater vigour than smaller seeds (Ellis, 1992). Seed size affects germination rate, emergence rate, the success of establishment, and growth (Sanderson *et al*., 2002; Ekpo, 2004). However, some conflicting results exist when seed size alone is used as a criterion to predict seedling performance (Belcher and Gresham, 1974; Barnett and McLemore, 1984). Seed parameters that may be closely related to size were probably more directly related to seed and seedling performance (Barnett, 1997). Ekpo (2004) found that larger Hairy Vetch seeds germinated faster than smaller ones. Genetic factors affect seed germination by influencing seed physiological quality (Soler-Guilhen *et al*., 2018).

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Early *Hevea* plantations were established from self-rooted seedlings with the disadvantage that they varied greatly in vigour and latex yield. To overcome this challenge, the grafting of seedlings was introduced (Masson and Monteuuis, 2017) with more uniform growth and yield. Information necessary to identify species in the field and among seed samples can be provided from seed and seedling characteristics (Beltrati, 1995). Interestingly, data from seed characterisation studies can be used to differentiate between species of the same genus (Cruz *et al*., 2001). In Cameroon, several clonal materials are planted in both estates and as well as smallholder plantations. There is limited information related to seed characterisation from these clones and early growth performance. This study, therefore, sorts to fill this knowledge gap.

Materials and methods

Plant materials

Five clones of *Hevea brasiliensis,* namely, GT1, PB 235, PB 260, PB 217 and PR107, which are among the most cultivated in Cameroon (Nicolos *et al*., 1992), were used. Seeds from these five clones were collected from the Cameroon Development Cooperation (CDC) rubber plantations. Seeds collected for individual clones were packaged in envelopes and labelled.

Seed characterisation

For each clone, 50 seeds were selected randomly for the measurement of seed length, seed width (circumference), kernel weight and shell weight. The length and width of seeds were measured using a meter rule, while the weights were measured with a 0.01 precision digital balance.

Seed germination

Germination beds of 3 m x 1 m dimensions were prepared prior to picking seeds. On these beds, a thin layer of sawdust was spread on the surface of the bed. 50 seeds were used per clone. The selected seeds were spread over the germination beds in a single layer in straight lines of 2 cm gap and gently pressed into the sawdust on their ventral part to a depth of 1.5 cm and lightly covered with sawdust. The germination beds were watered daily. The percentage of seeds that germinated was counted after two weeks (Junaidi *et al*., 2021).

Seedling height measurement

Seedlings heights were measured two weeks after sowing using a meter rule. Ten seedlings were measured per block.

Data analysis

The SPSS software package was used for data analysis, and differences between clones were sorted using ANOVA analysis, Tukey HSD at 5 per cent alpha level.

Results and discussion

Clonal variation in seed characters

Clone GT 1 had the highest seed length, seed kernel weight and total seed weight (Table 1), while clone PB 235 had the heaviest shell, lowest kernel weight, seed length and circumference. These results agreed with those of Annapurna *et al.* (2005), who showed that seeds of various clones exhibited significant variability in size, weight, percentage germination and initial seedling growth.

Table 1. Variation in *Hevea brasiliensis* seed characters

Clone	Length (cm)	Width/circumference (cm)	Kernel weight (g)	Shell weight (g)	Total weight (g)
GT 1	3.98b	6.56a	3.4b	1.60ab	4.75b
PB 260	3.60ab	6.10a	2.0a	0.88a	2.85a
PB 235	3.12a	6.02a	1.3a	1.96b	3.57ab
PB 217	3.54ab	6.70a	2.4a	1.20ab	3.25a
PR107	3.28a	6.02a	2.6ab	0.92a	3.43ab

*Values in a column followed by the same letter are not statistically different according to the Tukey test at a 5% level of probability

Clonal variation in the germination of seeds and height of the seedling

High germination percentage assures the planter that a sufficient number of seedlings will be available at planting. Parameters used to assess seedling quality include; seedling height and root collar diameter (Tumpa *et al*., 2021). Clone PR 107 had the lowest percentage of seed germination at 55 per cent after two weeks (Table 2), and clone PB 217 had the highest percentage of seed germination (92.5%). PR 107 clone presented the lowest average seedling height (5.6 cm). The highest seedling height was obtained for seedlings from PB 235 clone.

Table 2. Variation in per cent seed germination and seedling height

Clone	Germination %	Seedling height (cm)
GT 1	80.0 ab	7.45 ab
PB 260	85.0 b	6.25 a
PB 235	82.5 b	12.27 b
PB 217	92.5 b	10.72 ab
PR107	55.0 a	5.60 a

* Values in a column followed by the same letter are not statistically different according to the Tukey test at a 5% level of probability

Correlations between seed character, seed germination and seedling height

A highly significant positive correlation existed between seed length and seed kernel weight (0.649) (Table 3). Negative tendencies were found between seed length, seed width, kernel weight and percentage of seed germination. Total seed weight depended highly on kernel weight (r = 0.754), seed length, and shell weight. Seedling height was found to be highly correlated with the percentage of seed germination and seed shell weight. Annapurna *et al.* (2005) found that the seed size was not significantly related to percentage germination and initial seedling growth for a clonal seed orchard of *Santalum album*. Germination in nursery bags did not correlate to seed variables in Spanish cedar (*Cedrela odorata*) (Julián *et al*. 2019). Sujith *et al*. (1994) reported that the size of the *Ceiba pentandra* seed did not influence its germination. Jayasankar *et al.* (1999) reported that size characteristics had no or weak correlation with the percentage germination for teak seeds. The results of our study contradicted those of Anjusha *et al.* (2015), who found that the germination percentage of *Anacardium occidentale* is dependent on seed size.

Conclusion

Seed characters varied from one clone to another, and the germination percentages. With regard to seedling height, a significant clonal variation was found. Germination percentage and seedling height were very closely related, indicating that fast-germinating seeds grow much faster. Data from this study is very useful for *Hevea* nursery managers in terms of the choices of clones from where to collect seeds and planning.

Acknowledgements

The authors are grateful to the management of the Cameroon Development Cooperation for giving them access to their rubber fields.

Table 3. Correlations between seed character, per cent germination and seedling height two weeks after sowing

Parameter/correlation coefficient (r)	Seed length	Seed width	Kernel weight	Shell weight	Percentage germination	Seed total weight
Seed length	-					
Seed width	0.122					
Kernel weight	0.649 **	0.143				
Shell weight	-0.226	0.175	-0.252			
Percentage germination	-0.101	-0.039	-0.174	0.085		
Seed total weight	0.447 *	0.251	0.754 **	0.446 *	-0.101	
Seedling height	-0.283	-0.325	-0.325	0.402 *	0.529 **	-0.028

** Significantly correlated at the 0.01 alpha level: * Significantly correlated at the 0.05 alpha level

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