Influence of Selected Clonal Seedling Rootstocks on Growth of Young-Budded Rubber (*Hevea brasiliensis*)

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ABSTRACT

Rubber (*Hevea brasiliensis* Muell. Arg.) is propagated by grafting buds of selected clones on to unselected seedling rootstocks raised in polybags using young budding technique. Although seeds of all clones are used to raise rootstock nurseries, no information is available about the performance of seedlings of some newer clones on bud grafting and scion growth. In view of this, a study was conducted to examine the effect of rootstocks of some newer clones *viz.* RRISL 201, RRISL 206, RRISL 217, RRISL 220 along with some old clones *viz.* PB 86, RRIC 100 and PB 260 on growth of the scion of PB 260. Bud grafting success was 85- 90% with all rootstocks. Improved growth attributes of the scion was recorded with rootstocks of newer clones *viz.* RRISL 206, RRISL 220 and RRISL 217 as compared to old clones *viz.* PB 86 and RRIC 100. Improved root characteristics were also observed in rootstocks of some newer clones *viz.* RRISL 206 and RRISL 220 as compared to old clones such as PB 86 and RRIC 100. Therefore, rootstocks of RRISL 206, RRISL 220 and RRISL 217 could effectively be utilized to bud graft the scion of PB 260 to produce good quality young-budded rubber plants.

KEYWORDS: Bud grafting, Clone, Growth, Rootstock, Seedling

INTRODUCTION

Rubber (*Hevea brasiliensis* Muell. Arg.) plays an important role in Sri Lankan economy. During the initial stages of rubber cultivation, the rubber tree was exclusively propagated by seeds. However, currently rubber seeds are not used as a planting material merely because of variation among the individuals with regard to growth, vigor and yield, resulting in low productivity (Seneviratne, 2001). Therefore, the standard practice adopted in the commercial propagation of rubber clones is by grafting buds of selected clones on to unselected seedling rootstocks raised in polybags using young budding technique (Nayanakantha *et al.*, 2014).

In young budding, germinated seeds are placed directly in polybags and the plants that emerge are allowed to grow up to 3- 4 months until the diameter of the stem becomes 6- 7 mm. The plants are then bud grafted and successfully grafted seedlings are cut-back in order to promote the growth of the scion (Seneviratne, 2001). The quality of a young-budded plant depends on both the quality of the rootstock as well as that of the bud patch. Therefore, rootstocks play an important role in influencing the performance of scion after bud grafting. Until 1975, there were recommended clones such as Tjir 1, AVROS 163 and BD 10 to collect seeds for rootstock nurseries. However, as the clones recommended for plantations changed, the older ones recommended to collect seeds gradually disappeared from rubber plantations and therefore seeds of all clones such as RRIC 45, PB 86, RRIC 36, RRIC 52, *etc.*, were recommended to establish rootstock nurseries (Samaranayake, 1975). Nevertheless some clones such as Wagga 6278 were restricted to use in stock nurseries due to low success in bud grafting (Samaranayake, 1975).

Although seeds from some popular clones such as PB 86 and RRIC 100 are being used to establish rootstock nurseries at present, cultivation of PB 86 was stopped since mid-1990s and cultivation of RRIC 100 has been restricted (Nayanakantha, 2009). These clones are being replaced with some newer clones with high yielding potential under current scenario. Therefore, it is very much essential to study the seed production potential and seedling attributes of newer clones with special emphasis on bud grafting and post bud grafting performances with different scions.

Since the rootstocks are of seedling origin and heterozygous, their variability could influence the intra-clonal variability of the budded rubber plants. A number of experiments have been conducted to study the effect of rootstock on growth of scion in rubber clones (Buttery, 1961; Combe and Gerner, 1977; Ng *et al.,* 1981; Gonçalves and Martins, 2002) and some of these trials showed strong rootstock effect on scion yield. Therefore, selection of good rootstock is of utmost importance to obtain the maximum yield of scion.

Currently the rubber cultivation is being expanded into dry and marginal dry areas of Sri Lanka and hence abiotic stresses such as drought and heat would be the major impediments liming growth and development of rubber plants (Nayanakantha *et al.*, 2014). Since root system is vital to water and nutrients uptake of all plants, one can argue that rootstocks with a better root system would play decisive roles in growth and abiotic stress tolerance of grafted rubber trees with a specific scion clone. In view of this, present study aimed at evaluating the performance of seedling populations of some newer clones along with some old clones on their bud grafting and growth aspects with a known scion.

MATERIALS AND METHODS

Experimental Site

The study was conducted in a nursery at the Dartonfield estate of the Rubber Research Institute of Sri Lanka (RRISL), during the period from February to May in 2016.

Planting Material

About five months old poly bagged seedlings raised from illegitimate seeds of seven clones *viz.* RRIC 100, PB 86, RRISL 201, RRISL 206, RRISL 217, RRISL 220 and PB 260 were used for the study. Each clone was considered as a single treatment. Plants had been grown in black polythene bags, gauge 300 and having lay-flat dimensions of 15 cm diameter and 37 cm height. Polybags had been placed in shallow trenches close to each other as single rows with a distance of 1.5 feet between two single rows. Polybags had been arranged in a nursery according to a Randomized Complete Block Design (RCBD). Each treatment had 35 replicates arranged in seven blocks.

Each seedling was bud grafted with scions obtained from the clone PB 260 using green budding technique. Three weeks after bud grafting, polythene strip was removed from each plant and successfully grafted plants were pollarded at 15 cm above the bud patch one week after the removal of the polythene strip. Manuring and all other agro-management practices were done as recommended by the Rubber Research Institute of Sri Lanka (Anon, 2009).

Measurement of Growth Parameters of Budded Plants

Percentage bud grafting success was recorded after one month from grafting. When the first leaf whorl was matured, 14 plants from each treatment were removed randomly and root system was washed gently under running water over a 0.5 mm sieve and the adhering soil and other particles were carefully removed. Morphological attributes *viz.* diameter of the scion, length of the scion, angle of the scion and number of leaves were recorded. Leaf area was determined by using leaf area meter (Model L1-3100, LICOR, USA). Chlorophyll content was measured by using SPAD 502 Plus chlorophyll meter. Dry weights of shoots and roots were obtained by oven-drying the samples at 70 °C for 48 h.

Data Analysis

Significance of the observed treatment differences was tested by analysis of variance using proc. GLM procedure of the SAS software package (version 9.1) and significant means were separated using Duncan's Multiple Range Test (DMRT) at the 5% probability level.

RESULTS AND DISCUSSION

The mean stem diameter, height and number of leaves of the seedlings raised from seeds of different clones showed some variations at five months of age, *i.e.* at bud grafting stage (results not shown). However, the differences in growth within seedlings from each clone were less as compared to those from different clones (results not shown). Results of the present study revealed that bud grafting success was 85- 90% with all rootstocks and hence they all can successfully be utilized to raise rootstock nurseries to be bud grafted with scions of PB 260.

There was no significant difference in scion diameter, number of leaves, leaf area, chlorophyll content and dry weight of budded plants raised from rootstocks of different clones (Table 1). Nevertheless, there was a significant difference in length and angle of the scion of the budded plants raised from rootstocks of different clones (Figure 1). The highest scion diameter was recorded with the rootstocks raised from RRISL 206 followed by RRISL 220, RRISL 217 and PB 86 (Table 1). A significantly better scion angle (below 35°) was recorded from rootstocks derived from all the clones except for RRISL 217 (Figure 1). Nevertheless, maximum scion length was recorded with the rootstock raised from RRISL 217 (Figure 1).

Total plant size is a major scion trait that is controlled by the rootstock and has been shown in many plant families. Santos *et al.* (2004) examined rootstock mediated dwarfing in sweet cherry and found that trunk cross-sectional area (TCSA), final shoot length and final node number were significantly affected by different rootstocks

Table 1. Effect of rootstock on growth of scion of young-budded rubber

Treatment	Stem diameter (mm/plant)	No. of leaves (per plant)	Leaf area (cm^2/plant)	Chlorophyll content	Shoot dry weight
RRIC 100	6.57± 0.19	11.21± 0.69	751.99±82.08	52.61± 1.37	6.02± 0.74
PB 86	6.77± 0.30	11.73± 0.38	789.28±43.26	53.26± 1.3	6.53± 0.33
RRISL 201	6.16± 0.25	10.71± 0.78	667.48±39.31	53.06± 1.61	5.63± 0.66
RRISL 206	7.16± 0.16	12.00± 0.46	872.39±39.78	52.82± 1.33	7.22± 0.30
RRISL 217	6.83± 0.35	13.50± 2.01	973.19±183.18	56.73± 0.93	10.90± 2.30
RRISL220	6.92± 0.24	12.57± 0.64	781.56±103.18	51.95± 1.65	6.73± 0.73
PB 260	6.61± 0.15	11.97± 0.58	777.21± 96.88	49.20± 2.17	5.97± 0.66

The values are means and standard error (SE) of 14 seedlings (n=14). Means in a column are none significant at the 95% level of confidence

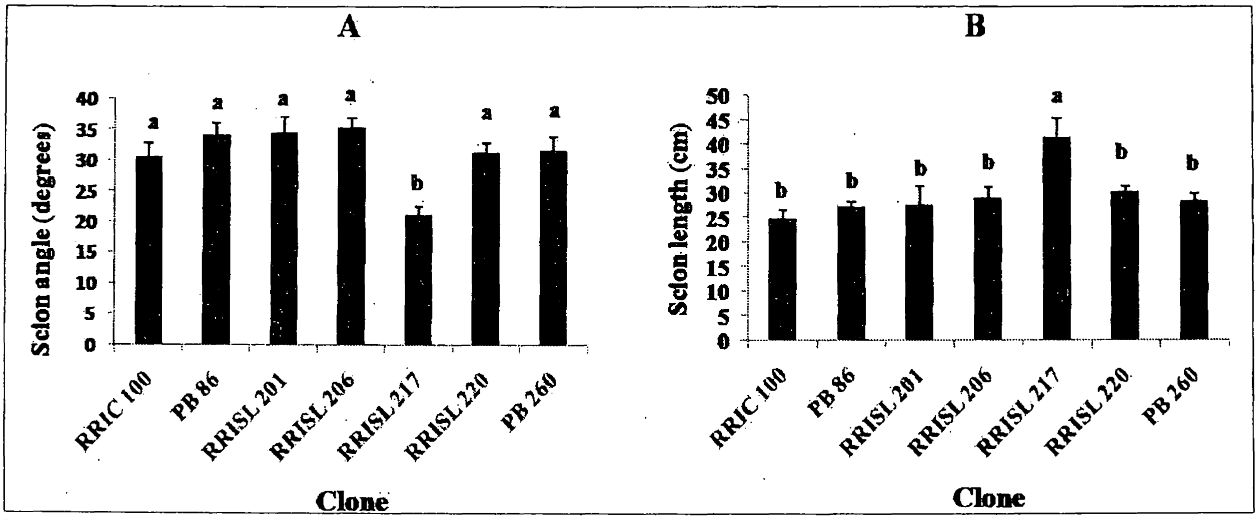

Figure. 1. Effect of clone on shoot characteristics of rootstock seedlings. *A- shoot angle (degrees), B- shoot length (cm). The values are means and standard error (SE) of 14 seedlings (n=14). Means with different letters in each graph are significantly different at 5% according to Duncan's Multiple Range Test*

Similarly, the rootstock demonstrated up to a 2.5 fold variation on the girth of peach trunks (Tsipouridis and Thomidis, 2005). Grafting of a clementine scion onto several interspecific citrus rootstocks significantly varied tree height, canopy diameter, circumference and tree volume (Bassal, 2009). Gijon *et al.*, (2010) showed that pistachio leaf area and leaf and stem dry weights varied based on the rootstock used.

Effect of the stock-scion interaction can have adverse influences on both growth and yield in bud-grafted rubber (Pathirana *et al.*, 2007). One of the problems when choosing the right scion/rootstock combination is in predicting how the scion and rootstock genotype will interact. Interaction usually results from the mutual translocation of nutrients and growth regulators between the scion and rootstock (Sorce *et al.*, 2002). Thus, an early and accurate detection of bud grafting and growth performance of newer clones with known scions are very much essential in selecting better rootstock that can influence growth as well as abiotic stress tolerance in rubber clones.

Hormone examinations have also been reported in perennial grafted plants. Sorce *et al.* (2002) demonstrated that in peach variety 'Armking' on three interspecific rootstocks, scion levels of zeatin riboside and indole acetic acid (IAA) amounts were significantly controlled by the rootstock. Vigor of the plants was positively correlated to zeatin riboside concentrations and negatively with IAA concentrations. Due to the examination of ungrafted control rootstocks, the authors were able to note that IAA and zeatin riboside were balanced in the ungrafted plants. That balance was not seen in the grafted plants suggesting the hormonal conversation between the rootstock and scion was altered which could explain the changes in vigor. Seedlings of newer clones might possess some improved hormonal signaling cascades which can enhance the growth of the scion.

As far as the root system of the stock seedlings is concerned, the highest root dry weight was recorded from RRISL 220 followed by PB 260 and RRISL 206 (Figure 2). The growth of the scion was better with rootstocks of RRISL 206 and RRISL 220.

Although RRISL 217 showed the lowest value for root dry weight, length of the scion was better with RRISL 217 as compared to rootstocks raised from other clones (Figure 2).

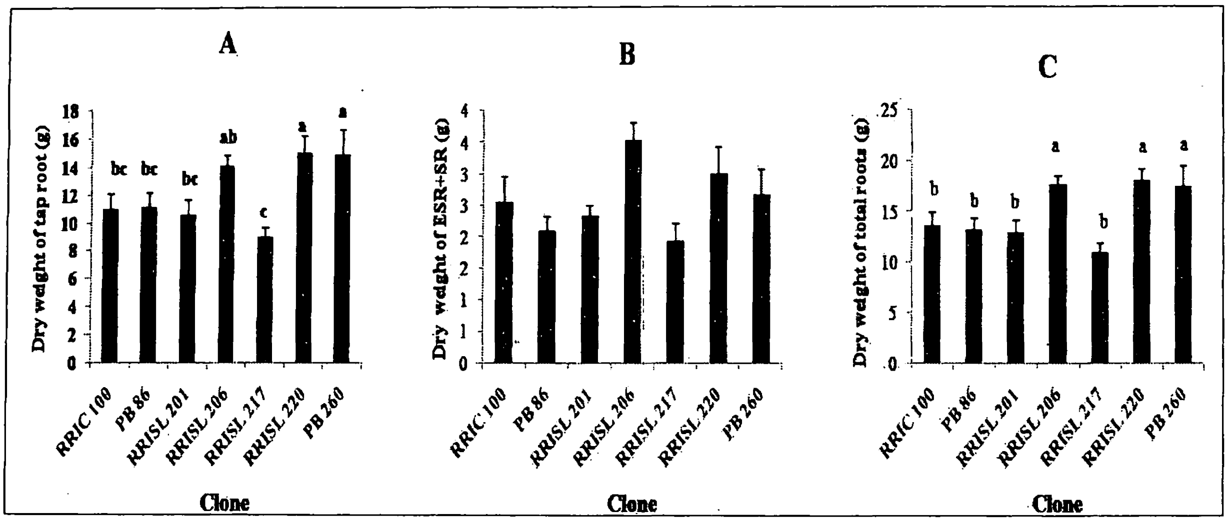

Figure. 2. Effect of clone on root characteristics of rootstock seedlings of young-budded rubber plants at one leaf whorl stage. *A- dry weight of tap root, B- dry weight of early secondary roots (ESR) and secondary roots (SR), C- dry weight of total roots. Means with different letters in each graph are significantly different at 5% according to Duncan's Multiple Range Test*

Ng *et al.* (1981) showed that rootstocks could significantly influence the growth and yield of the scions, although without rootstock × scion interaction.

Ahmad (1999) demonstrated the effect of rootstock on growth and water use efficiency of different rubber tree clones, whereas Sobhana *et al.* (2001) studied the physiological and biochemical aspects of stock/scion interaction in *Hevea.*

Although the scion of PB 260 showed some better performance in growth and bud grafting with rootstocks of some newer clones, it is essential to study the bud grafting and growth performance of other recommended clones in group 1, such as RRIC 102, RRIC 121, RRIC 130, RRISL 203 and RRISL 2001, with the rootstocks examined in the present study for better understanding of the stock- scion interaction and production of good quality young budded plants.

CONCLUSIONS

Budded plants from PB 260 can successfully be produced using the rootstocks raised from seeds of some newer clones.

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