Research Article

Journal of Plantation Crops, 2014, 42(1): 6-10

Influence of young and mature budwood plants on growth and tappability of rubber

V.C. Mercykutty*, T. Gireesh and Kavitha K. Mydin

Rubber Research Institute of India, Kottayam - 686 009, Kerala, India

(Manuscript Received:28-06-13, Revised:12-08-13, Accepted: 05-10-13)

Abstract

Healthy buds from four year old young budwood plants, 20 year old mature budwood plants and 20 year old mature trees were collected and bud grafted onto seedling stock of recommended age and size in the ground nursery and the resultant budded stumps were raised in polybags. The plants were subjected to field evaluation during 2006. At the age of seven years, trees raised from young budwood plants recorded mean girth of 45.6 cm,while those from mature budwood plants had mean girth of 42.2 cm and trees raised from buds of mature trees showed significantly inferior girth of 33.7 cm. Trees raised from young budwood plants showed lesser tree to tree variation (CV: 12.76-14.79) coupled with significantly higher percentage of tappability (60.17%). Trees raised from mature budwood plants recorded higher tree to tree variation (CV: 15.47-19.68) with 39 per cent tappability. Plants developed from the tree buds recorded only 11 per cent tappability (CV: 23.11). Present study indicated that trees generated from young budwood plants showed higher tappability with better uniformity in girth than trees raised from mature budwood plants and mature trees.

Keywords: Budwood, growth rate, *Hevea brasiliensis,*tappability

Introduction

Rubber being propagated predominantly through vegetative methods, exhibits tree to tree intra-clonal variation in growth and yield which reduces the realization of maximum returns of a clone (Jayasekera and Senanayake, 1971; Senanayake, 1975; Senanayake *et al.,* 1975). Intra-clonal variation in growth delays the opening of the trees for tapping and results in reduction of yield in rubber plantation. Inferior quality of planting materials is one of the main reasons for growth variation of the trees and not achieving the potential rubber yield (Seneviratna, 2000; Senevirathna *et al.,* 2007). If the planting materials are of high quality, the growth and vigour of the plants will be uniform, thereby reduces the immaturity period and increase the productivity with the adoption of timely management practices and exploitation systems.

The quality of budwood plants from which buds are harvested for budding, is as important as any other factors, which contribute to the quality and growth of plants. The recommended life span of budwood nursery in Sri Lanka is 10 years (Seneviratna, 2000; RRIC, 2002) and those budwood plants which attained more than 10 years of age are not recommended as the source of buds for budding operations. In India, many rubber nurseries are retaining budwood plants for more than 10 years assuming that it would not deteriorate quality of budwood or buds as juvenility is maintained through cutting back the budwood plants every year. It was also noted that when there is shortage of budwood, buds are harvested directly from mature trees for bud grafting. Laxity in maintaining budwood nurseries are transferred to plantation and the economic impact of this process has been discussed earlier (Leconte *et al.*, 1996). In this context, the variation in growth and tappability of rubber trees raised from mature and young budwood plants as well as mature trees were studied and the results are discussed.

**Corresponding Author: mercykuttyvc@rubberboard.org.in*

Materials and methods

Healthy one year old budwood of the clone RRII 105 collected from young and mature budwood nurseries was used for the present study. Buds were collected from four year old budwood plants from four locations (Nursery A, B, C and D) representing young budwood plants and 20 years old plants from two locations (Nursery A and B) representing mature budwood plants. These buds were grafted onto seedling stock of one year old plants raised in Central Nursery, Karikkattoor. At the C and D budwood nurseries, mature budwood plants were not available, as budwood plants were replanted every 10 years. Buds from new shoots emerged from the main trunk of 20 year old mature trees of RRII 105 were also collected and bud-grafted on stock seedlings of suitable age and size. Successful bud grafts were raised in black, low density polybags (55x25 cm size and 400 gauge thickness) and when the plants attained 2-3 whorls, field trial was laid out at the Central Experimental Station of Rubber Research Institute of India at Chethackal in Central Kerala, India during the planting season of 2006 for evaluation of the following treatments.

Polybag plants raised by buds collected from young budwood plants of nursery A (T1), nursery B (T2), nursery C (T3), nursery D (T4), polybag plants raised by buds collected from mature budwood plants of nursery A (T5), nursery B (T6) and polybag plants raised by buds collected from the mature trees (T7).

The trial was laid out in randomized block design with 3 replications having nine plants per plot in each treatment. All recommended practices were taken up for field upkeep. Data were collected on budding success (%) in the ground nursery, establishment (%), and growth parameters of scion in the polybags, such as height (cm), basal diameter (mm) and internodal length (cm). The girth of the trees in the field was recorded annually from the third year of planting onwards and continued for the subsequent four years to determine the girth increment (GI) rate during the pre-tapping phase and assessment of tappability of the trees during 7th year after planting.

Results and discussion

Buds collected from young or mature budwood plants did not show any influence on budding success, establishment and growth parameters of scion after seven months growth in polybags (Table 1). Irrespective of the treatments, budding success ranged from 77-85 per cent and establishment success ranged from 81-94 per cent. Though the plants originated from young budwood plants exhibited slightly better growth characters,the difference was statistically significant (p=0.05) only for height of scion in one treatment. Significantly low values for growth parameters were exhibited in plants raised from buds collected from mature trees.

The annual growth rate is considered as the most important parameter for an immature plantation. Figure 1 shows the extent of variation for girth increment rates in the pre-tapping phase. The girth increment rate was comparatively higher in trees originated from young budwood plants. Girth increment rate was significantly inferior in trees, where buds were collected from the mature trees.

Table 2 shows the girth and coefficient of variation among the trees in the seventh year of

Table 1. Budding success, establishment success and growth of plants in the polybags

Treatments	Budding success (%)	Establishment success (%)	Height of scion (cm)	Diameter of scion (mm)	Internodal length of scion (cm)
T1	81.6	93.9	83.3	6.9	38.5
T2	82.4	85.4	79.8	7.1	37.2
T3	85.2	88.4	87.3	6.8	34.6
T4	85.0	80.6	85.2	6.7	35.4
T5	80.4	90.8	74.6	6.6	34.4
T6	83.6	86.3	80.1	6.7	35.0
T7	77.0	80.5	22.5	3.3	13.5
CD (P= 0.05)		NS	12.6	2.1	6.42

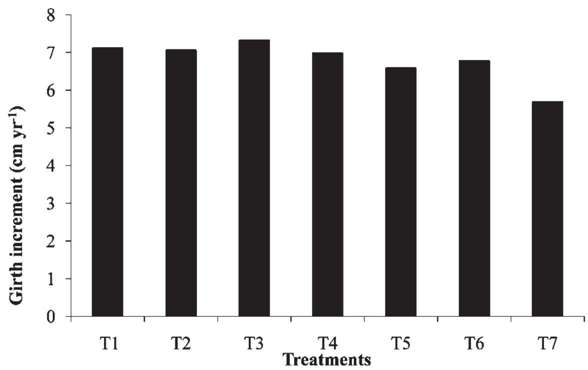

Fig. 1. Effect of age of budwood on girth increment

Table 2. Variation in girth at 7th year

Treatments	Girth (cm)	Range	SD	SE	CV
T1	46.3	32-55	5.89	1.16	12.76
T2	44.5	31-55	6.57	1.29	14.67
T3	46.7	32-60	6.89	1.35	14.79
T4	45.1	30-55	6.54	1.28	14.70
T5	42.0	25-55	8.27	1.62	19.68
T6	42.5	28-52	6.57	1.29	15.47
T7	33.7	17-49	7.79	1.53	23.11
CD (P= 0.05)	4.91	-	-	-	-

growth. In the population, the mean girth of the trees ranged from 33.7 to 46.6 cm. Trees raised from young budwood plants, in general, recorded better vigour at opening with mean girth of 45.6 cm. The girth ranged from 30 to 60 cm. Mean girth of the trees from mature budwood plants was 42.2 cm ranging from 25 to 55 cm and those with buds from mature trees had a mean girth of 33.7 cm ranged from 17 to 49 cm. Coefficient of variation among trees originated from young budwood plants ranging from 12.8 to 14.8, whereas those from mature budwood plants recorded higher variability of 15.5 and 19.7. Plants with buds from mature trees recorded the highest CV of 23.1. Morphologically plants from mature trees were characterized by crooked stem with knots on the trunk, which further reduced the girthing of the tree. In general, trees originated from mature budwood plants recorded higher intra-clonal variation in girth compared to that of trees raised from young plants as judged from coefficient of variation. The results indicate higher intra-clonal variation among the plants and low growth rate followed by increase in immaturity period when buds were collected from mature budwood plants as well as mature trees.

Tapping is initiated in a rubber plantation in India when 50-70 per cent trees attain the tappable girth of 50 cm at 125 cm height. It takes an average of seven years to reach this stage under good agro-management conditions.The practice of tapping trees on attainment of a girth of 45 cm is also adopted by some large growers in India which is the standard procedure recommended in Malaysia and by the IRRDB (IRRDB, 1984). Table 3 shows the tappability in various treatments in the seventh year after planting. In the young group, at 45 cm girth, percentage tappability ranged from 51.3 to 70.7, whereas in the mature group it was from 38.5 to 39.7. The poor growth rate of RRII 105 before and during tapping was reported earlier (Mydin and Mercykutty, 2007). Buds harvested from mature trees recorded only 11.1 per cent of tappability with the girth of 45 cm.

Table 3. Attainment of tappability at 7th year

Treatments	Percentage of trees that attained girth of	
	45 cm	50 cm
T1	59.3	37.0
T2	51.3	24.0
T3	70.7	34.6
T4	59.3	25.9
T5	39.7	19.2
T6	38.5	19.2
T7	11.1	0.0

The percentage of trees that attained mean girth of 45 cm and 50 cm were grouped. Trees raised from young budwood source showed significantly higher percentage of tappability with an average of 60.2 per cent in terms of 45 cm and 30.4 per cent in terms of 50 cm as compared to 39.1 per cent and 19.2 per cent respectively in mature budwood plants (Fig. 2). An increase of 54 per cent and 58 per cent tappability was recorded by young budwood plants compared to mature plants at 45 cm and 50 cm respectively. The data revealed that per cent tappability was higher when the buds were collected from the young budwood plants. Quality of buds determines the quality of the plants in terms of growth and tappability.

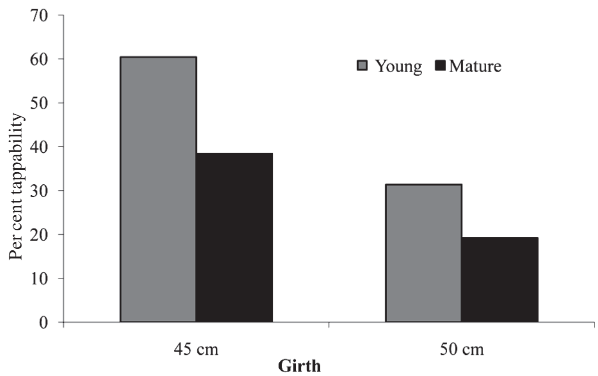

Fig. 2. Tappability: Young *vs.* mature phase

Present study indicated that young budwood plants showed superiority in terms of quality of planting materials as it recorded better growth rate, girth at opening and tappability coupled with uniformity in growth than plants evolved from mature budwood plants. In a rubber plantation, the growth rate is important to attain the productive phase early. Early tapping and high precocious yield from trees is important when discounted cash flow and return on the investment is considered (Wycherley, 1969; Mydin and Mercykutty, 2007).

Generally from the seed up to 4-5 years of age is considered as young stage and trees above 6-7 years are considered as mature stage (Seneviratne, 2000). As the budwood plants are pollarded every year, the plants always remain in their young juvenile phase with no flowering or wintering as seen in the mature trees. Juvenility is amenable for transformation and is characterized by higher and uniform growth rate. When the distance between shoot tips and root system increases with years, the juvenility of the meristem gradually disappears and the young shoot becomes physiologically mature *i.e.* the terminal parts of a plant are ontogenetically the most mature ones though chronologically it is the youngest one. When the harvesting point moves away from the base of the tree the plants may have accumulated certain degree of maturity with the age of plants. Further, rubber being a woody perennial tree it gains maturity with the age which is characterized by slow growth rate.

When there is shortage of budwood for budgrafting, sometimes buds are harvested from mature field grown plants. This will expedite the process of maturation and lead to exhibit mature characteristics such as slow growth, early wintering, flowering and associated stem characters. Grafted plants, with no chance given for reversal to juvenile phase for a number of years, will be also be mature. However, when they are grafted to a young root stock closer to the root system, certain amount of reversion or regeneration occurs in the scion which in turn resulted into a delay in the transition phase (Seneviratna, 2000). As the girth of the tree determines the attainment of tappability, slow growth rate will prolong the immature period.

Any attempt that would help to reduce the variability by improving the growth would enable the rubber plantation to obtain uniform stand and higher productivity. Use of poor quality budwood would results in establishment of substandard plantations with poor growth rate causing prolonged immaturity period. This study indicated that trees generated from young budwood plants showed higher tappability with better uniformity in girth than trees raised from mature budwood plants and mature trees. Use of buds from mature budwood plants increases the variability in growth of the trees as well as reduces early tappability of a clone. Hence, it would be advisable to use budwood from young source-bush nurseries for multiplication of planting materials in rubber.

Acknowledgement

The authors are grateful to Dr. James Jacob, Director of Research, Rubber Research Institute of India for providing facilities and encouragement to carry out this study. The support rendered by Mr. Sabu P. Idicula is gratefully acknowledged.

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