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GROWTH AND TAPPABILITY OF RUBBER TREES PRODUCED FROM VARIOUS PLANTING MATERIALS

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The results of two studies on planting materials raised by different budding techniques are discussed. Modified young-budded polybag plants of RRII 105 were field-tested at 11 locations in the traditional rubber growing tract of Kerala extending from Thamarassery in Kozhikode District to Punalur in Kollam District, in comparison with conventional brown (eight locations) and green-budded polybag plants (three locations). Both the test and control saplings were raised in the holdings during the planting season of 2002 in compact blocks with plot size varying from 250 to 500 plants, following standard practices. Direct-seeded bud-grafted plants grew at a faster rate soon after field planting than budded stumps. However, after seven years of growth, the modified young buddings were comparable in girth and tappability with brown-budded stumps in five out of eight locations, and with green-budded stumps in all the three locations. Significantly higher girth seen in young budding in two out of eight locations might be due to significant difference in the initial quality of planting materials. Data show that differences in initial girth between modified young-budded plants and brown-budded plants get reduced over time. It appears that commercial value of young budding as a method of propagation is not superior to conventional brown and green buddings. Another experimental planting at Rubber Research Institute of India also revealed that girth and tappability of trees that originated from brown, green and modified young budding techniques were statistically on par at the time of opening.

From the experiments in holdings and from the statistically laid out trial, it is inferred that, with the adoption of uniform and scientific agromanagement practices, girth attainment and immaturity period of planting materials that originate from different budding techniques within the same clone are comparable.

Keywords: Brown buddings, Green buddings, *Hevea brasiliensis*, Modified young buddings, Propagation

INTRODUCTION

Rubber plants were first bud-grafted in 1916 using the technique of brown budding, which made vegetative propagation commercially viable in the species by way of the advantages of better uniformity in vigour and yield over seedling rubber. In brown budding, buds from one-year-old shoots are grafted onto rootstocks of more or less similar age. By 1936, this technique was widely practised by the estate sector and smallholdings world over. Later, the green budding technique was introduced in 1960, where 2-8-month-old stock plants were grafted with buds taken from 6-8-week-old green shoots (Hurov, 1960). The major advantage of green budding technique is reduction in rootstock nursery time by about

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six months and thereby reduction in cost compared to brown budding technique. Planting either type of budgrafts as bare-root budded stumps is cheaper, but at the same time there are the disadvantages of low field establishment rate and uneven growth in the field. Tinley (1962) reported that budded materials raised in nurseries could be transplanted into polythene bags and this could be transplanted into the field after the plants reached two-whorl stage. Green buddings raised directly in polybags with an undisturbed root system greatly assist survival even if planting is followed by adverse weather.

The Rubber Research Institute of Malaysia launched young budding in 1985, wherein even smaller rootstocks that were less than two months old, grown directly in small polybags (15 x 33 cm lay flat dimensions) which can hold about 2.5 kg of soil, were used. Since there are two seedfall seasons and two planting seasons in a year in Malaysia, young budding technique which has a short production cycle of 6-7 months is adaptable to the climatic conditions prevailing there (Leong and Yoon, 1985). Using the same technique, production of young-budded plants with two to three whorls is possible in India by the month of February. However, the climatic conditions in India during this period are not favourable for field planting. Hence, an alternative method of postponing cutting back of the bud-grafted plants to February – March period was adopted for this study. The plants raised were termed as modified young-budded plants and the total production time in the nursery became almost similar to that for the conventional green-budded polybag plants (Kuriakose, 2002; Mercykutty *et al.*, 2005).

In Malaysia, young-budded plants are considered improved planting materials mainly because of their short production cycle, due to which they provide a flexible planting system for various planting seasons in a year. Little information is available on the comparative merits of various types of planting materials in the reduction of immaturity period. The present study aims to evaluate the immature phase of trees originating from modified young buddings and conventional buddings, *viz*. brown- and green-budded plants, in holdings as well as in the RRII experimental station.

MATERIALS AND METHODS

Studies in holdings

The study was conducted in small growers' fields in 11 locations in the traditional belt of Kerala, extending from Thamarassery in Kozhikode District to Punalur in Kollam District. The locations were Kozhikode, Mannarkad, Shoranur, Muvattupuzha (I) & (II), Thodupuzha, Kottayam, Kanjirappally, Pathanamthitta and Punalur.

Healthy modified young-budded polybag plants of the clone RRII 105 raised in black polythene bags (40 x 10 cm) were purchased from a commercial nursery. These saplings were planted in all the 11 field sites during the southwest monsoon period of 2002, in compact blocks with plot size of 250-500 plants, following standard practices. Normal brown/green-budded polybag plants of the same clone, produced as per the standard practice and purchased from local private nurseries, were planted in the adjacent area in a block and served as control. The growers were instructed to follow same standard

agromangement practices in both test and control plots.

Growth rate was analysed in terms of girth and tappability. Diameter of the scion was recorded from the field-grown plants during the first year (2003) using a calliper and then girth was computed. Girth recording of the trees was repeated in 2009 after seven years of growth, at a height of 1.25 m. Girth values of randomly selected 100 plants were recorded and 't' test was employed to compare the growth performance. Comparison of per cent tappability of young budded plants and the respective control in each location was done using the two sample z-test for proportions.

Planting at the RRII experiment station

Different types of planting materials such as green, brown, modified young-budded polybag plants of 2-3 leaf whorls and bare-rooted brown-budded stumps of clone RRII 105 were planted in the field of the Central Experiment Station of RRII at Chethackal, adopting Randomized Block Design with three replications in 2000. Green-budded polybag plants were raised by transferring six-month-old green-budded stumps into 55 x 25 cm polythene bags, and field-planted at the two-three leaf storey stage. In the case of brown-budded polybag plants, 12-month-old brown-budded stumps were transferred to 55 x 25 cm polythene bags and field-planted at the two/three leaf storey stage. For modified young-budded plants, seedlings raised in 40 x 10 cm polythene bags were green-budded at 42 days, 49 days and 56 days. Successfully bud-grafted plants were opened after one month, though cutting back was delayed till January/February. All the types were field-planted at the two/three leaf storey stage. The data on growth and tappability after seven years of growth were statistically analyzed.

RESULTS AND DISCUSSION

Studies in holdings

The girth and percentage tappability of the modified young-budded plants and their respective control plants recorded in first and seventh year after field planting in the 11 locations are furnished in Tables 1-3. Attainment of a girth of 50 cm at a height of 1.25 m from the bud union is referred to as tappability in rubber trees (Vijayakumar *et al.*, 2000). Mean girth and tappability in the seventh year in young and respective brown-budded plants were found to be comparable in five locations, *viz*. Mannarkad, Shornur, Muvattupuzha (II), Kanjirappally and Pathanamthitta (Table 1). The pooled mean girth of trees originating from young-budded plants in five locations was 48.09 cm (ranging from 44.21 to 52.90 cm) while mean girth of brown-budded plants was 47.91 cm (ranging from 43.40 to 52.50 cm). Mean tappability was 72.20%, (ranging from 46.00 to 92.00%) in the case of modified young-budded plants and 73.20% (ranging from 43.00 to 92.00 %) in the case of brown-budded plants. The present data revealed that girth of modified young and conventional brown buddings were fairly comparable by the time the trees attained tappable girth. Results showed that by planting modified young buddings mean girth attained in the field after one year was 4.51 cm compared to 4.26 cm for normal brown budding. Though young buddings look smaller at the time of planting, they grow at a faster rate soon after the field establishment and there is hardly any

Table 1. **Girth and tappability of modified young and brown buddings in five locations**

Location	Mean girth (cm)1st year		Mean girth (cm)7th year		Tappability (%)	
	Young	Brown	Young	Brown	Young	Brown
Mannarkkad	5.31	5.28	52.90	52.50	92.00	92.00
Shornur	4.47	4.65	47.21	45.80	59.00	57.00
Muvattupuzha (II)	3.90	3.80	48.75	49.20	82.00	88.00
Kanjirappally	4.31*	3.52	44.21	43.40	46.00	43.00
Pathanamthitta	4.57	4.05	50.38	48.65	92.00	90.00
G. mean	4.51	4.26	48.09	47.91	72.20	73.20

*Significantly different from respective control plants

setback in growth, as also reported by Leong and Yoon (1985).

In three locations, *viz.* Kothamangalam, Kottayam and Punalur, modified young-budded plants registered comparable girth with corresponding green-budded plants, with a mean girth of 49.10 and 49.45 cm respectively in the seventh year; hence the differences in per cent tappability were not significant (Table 2). Mean tappability of modified young-budded plants was 82.58%, whereas in green-budded plants it was 84.33%. Technically, modified young budding is exactly the same as green budding on stocks raised by direct seeding in polybags, except for the age at which budding is performed (Soman *et al.*, 2010). The production cycle of two-whorled modified young budding is about 10-12 months which is comparable with the time required for production of two-whorled green buddings. The buds in the axil of a leaf scale on the green bud stick used for young budding usually produces a plant similar to that produced by conventional green budding.

At Kozhikode and Muvattupuzha (1) (Table 3), young buddings had significantly higher girth and tappability than brown-budded plants, whereas at Thodupuzha brown-budded plants were significantly superior to young-budded plants for these traits. Difference in growth in Kozhikode and Muvattupuzha (I) could be due to significant difference in girth in the initial stage as evident from the girth data during the first year. At Thodupuzha, significantly better growth of brown-budded plants throughout the period of study was noticed and this might be due to soil heterogeneity

Table 2. **Girth and tappability of modified young and green buddings**

Location	Mean girth (cm) 1st year		Mean girth (cm) 7th year		Tappability (%)	
	Young	Green	Young	Green	Young	Green
Kothamangalam	3.61*	2.31	48.96	47.81	80.76	77.00
Kottayam	4.44*	3.84	47.40	48.50	87.00	89.00
Punalur	3.20	3.31	50.95	52.05	89.00	90.00
G. mean	3.75	3.15	49.10	49.45	82.58	84.33

*Significantly different from respective control plants

Table 3. **Variation in girth and tappability of modified young and brown buddings in three locations**

Location	Mean girth (cm)1st year		Mean girth (cm)7th year		Tappability (%)	
	Young	Brown	Young	Brown	Young	Brown
Kozhikode	4.23 *	3.66	49.55 *	45.50	86.00 **	60.00
Muvattupuzha (I)	3.26 *	2.71	44.97 *	39.66	57.00 **	33.00
Thodupuzha	3.19	4.20 *	45.18	52.30 *	70.00	95.00 **

*Significantly different from respective control plants

or random variations in microclimatic conditions, differences in soil moisture and associated changes in dry matter production.

Tapping is initiated in a rubber plantation when 70% of the trees attain the tappable girth of 50 cm. It takes an average of seven years to reach this stage under scientific agromanagement conditions. In three locations, *viz.* Shornur, Kanjirappally and Muvattupuzha (I), the percentage of trees that attained tappable girth in the 7th year for both modified young-budded plants and its control plants was 59 and 57%, 46 and 43% and 57 and 33% respectively. A technical comparison of the performance of the two types of planting material in these three locations thus does not seem valid.

Out of the eleven locations, tappability figures for trees raised by modified young budding with those of the control were comparable in eight locations. The results of this study clearly indicates that there is no statistical difference ($p<0.05$) between the girth of different types of planting materials (modified young-budded plants and brown/ green-budded plants) as evident from the general means.

Planting at the RRII experiment station

Analysis of variance showed that there was no significant difference in girth at opening among the different types of planting materials (Table 4; Fig. 1). In the first year of growth, it was observed that modified young buddings had caught up in

Table 4. **Girth and tappability in brown, green and modified young buddings at CES, Chethackal**

Planting material	Mean girth in 1st year (cm)	Mean girth in 7th year (cm)	Tappability in 7th year (%)	CV
Brown budded stumps	3.92	47.73	66.67	12.84
Brown buddings	4.48	49.77	86.67	8.13
Green buddings	5.06	51.86	86.67	8.87
Modified young buddings-stock 42 days	4.77	50.20	93.33	7.96
Modified young buddings-stock 49 days	4.75	47.00	80.00	9.61
Modified young buddings-stock 56 days	4.44	49.64	86.67	8.54
SE	0.16	1.26	0.45	-
CD (P=0.05)	0.51	NS	NS	-

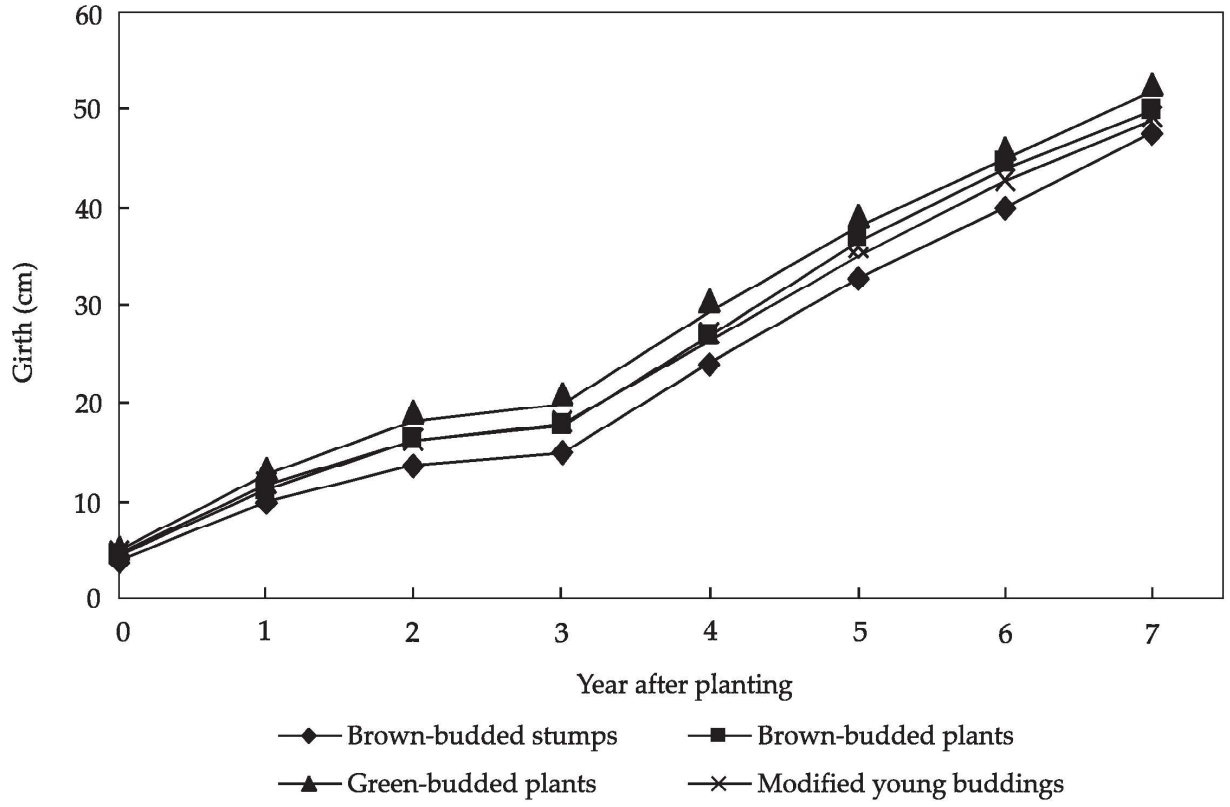

Fig. 1. Girth of modified young buddings and conventional buddings

girth with conventional brown buddings. By planting out with young buddings one season earlier, instead of retaining the plants longer in the nursery as in conventional brown budding, mean growth attained in the field was 4.65 cm compared to 4.48 cm for brown-budded plants. This indicated that though two-whorled young/green buddings appeared smaller at the time of planting, they grew fast soon after field establishment. Comparison of measurements after seven years also showed that modified young buddings and conventional buddings were on par in growth. From the 18th month onwards, girth of young-budded and brown-budded plants became fairly comparable with each other as reported earlier (Leong and Yoon, 1985).

Girth of plants originating from bare-rooted brown-budded stumps was significantly inferior to polybag plants until the plants completed four years of growth. Higher variability in girth was noted in plants raised from bare-rooted brown-budded stumps owing to differences in the time of bud sprouting and scion growth. Mean tappability of polybag plants was higher (87%) than the directly field-planted budded stumps (67%). An earlier report showed that in the ninth year of planting, the tappability of polybag plants was higher at 92.80% compared to 83.50% for budded stumps (Marattukalam and Nair, 1982). The highest girth combined with better tappability in green-budded polybag plants might be due to the possibility of selection

of inherently vigourous rootstock plants from a large population which ensures development of better root system.

It can be concluded that the practice of adoption of different types of budding techniques such as young, green and brown budding does not adversely affect the girth of rubber plants in the field. Growth of modified young buddings, brown buddings and green buddings was fairly comparable with one another. Though tappability is comparable among the different planting materials, less time required for production of green and modified young buddings is an advantage. When polybag plants raised from modified young and conventional budding techniques adopting proper agromanagement practices are transplanted carefully to the field, the root system remains undisturbed and this helps the scion shoot to continue its more or less uniform growth with no setback. The conventional polybag plants have no practical limitations which restrict their use in rubber planting.

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