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Research Article

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Young budding in *Hevea* – nursery evaluation

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Abstract

An attempt was made for comparing young budding with the conventional method of green budding. Treatment consisted of budgrafting on stocks at the age of 6, 7 & 8 weeks after planting the sprouted seeds in small polybags. The study was conducted during three consecutive years. Higher percentage of buddable stock was available for young budding purpose at a time compared to availability of buddable stocks for green budding. Budding success on eight weeks old stocks was comparable with that of green budding. Seven months after the stock plants were cut back, difference in scion growth in young and green buddings was significant except for diameter. However, before the 1st whorl of leaves matured, higher percentage of die back of the scion shoots was noted in young buddings, whereas die back was low in green buddings resulting in more recovery of usable bag plants. The recovered young budded plants were become ready for field planting by the month of February. The feasibility of young budding under Indian and Malaysian conditions is also discussed.

Key words: Young budding, green budding, *Hevea*, non buddable plants, ground nursery

Introduction

In *Hevea*, propagation by vegetative methods was initiated with the introduction of brown budding on one year old stock seedlings by Van Helten in 1916 (Dijkman, 1951) and later modified by Forkert in 1919. Subsequently Hurov (1960) perfected the technique of green budding on 2-8 months old stock using the buds located on the axils of scale leaves and recommended the same for large scale cultivation of *Hevea* in view of their initial lead of growth, short production cycle etc. (Hurov, 1960). Under Indian conditions, stock plants are grown for about 10 months in the ground nursery for brown budding and around 5 months for green budding to attain the buddable size. For young budding, instead of a ground nursery, seedlings are raised in smaller polybags and bud grafting is done on very young stocks below two months. Considering the various advantages as an improved propagation technique, young budding has been recommended for large scale planting in Malaysia, since 1985 (Leong & Yoon, 1985; Ong et al., 1989; Tiong Kheng, 1988, Ng *et al.*, 1991). Rubber Research Institute of Sri Lanka recommends "young budding" as a source of superior planting material in view of better and uniform growth of the scion shoots (Seneviratne, 1995) on budding of stock aged three months. Though in these rubber producing countries, the benefits of young buddings are well documented, in India, green and brown buddings are still recommended for large scale propagation of *Hevea*. The present study on young budding technique was undertaken with a view to exploit the potential value of young budding in the nursery stage and to compare the technique with the existing commercially adopted green budding technique in India.

Materials and Methods

For producing young buddings, stock seedlings were raised in polybags with lay flat size of 36 cm x 16 cm and 0.125 mm thicknesses, which can hold 2.5 kg soil. The bags were black and perforated at the lower half. The topsoil used for filling polybags were sieved and mixed with rock phosphate at the rate of 75 gm per bag.

The bags were arranged continuously in shallow trenches in rows at a spacing of 75 cm between rows. In each bag two sprouted seeds collected from the germination bed were planted. Planting was done in early August. Early germinated seeds alone were used for

planting in the polybags.Weaker seedling from each pair was removed from the bag 10 days after planting. Runts that subsequently appeared were replaced within a few days. Vigorous growth of the seedlings was maintained by weekly application of cow dung slurry combined with 1.0% NPK. Alternate weekly spraying of Dithane M-45 (0.2%) and Bavistin (0.05%)) was done to control leaf diseases. Strict adherence to fertilizer and fungicides schedules were followed throughout the period of study in order to obtain healthy stock and scion. Adequate watering was provided during the dry spell with a sprinkler system. Bags were kept devoid of weeds by regular weeding.

Treatments consisted of bud grafting on stocks at the age of 6, 7 & 8 weeks after planting the sprouted seeds in the polybags. Treatments were randomized with five replications and each plot had 70 bags (350 plants per treatment). The experiment was conducted for three years consecutively during 1998-2000 period. In 1999 and 2000 number of plants in each treatment was reduced to 175. For control treatment the seedlings were grown in the ground nursery for conventional green budding.

For all the buddings, buds of RRII 105 taken from the axils of scale leaves of green bud sticks were used. Green bud sticks were obtained from the existing budwood nursery by cutting back the stem to within 75 cm of the union. The healthiest shoots produced about four weeks after pruning and having about 3-4 mm diameter were used as bud sticks for young budding whereas sticks with leaves in leaflet stage (copper coloured) were used for green budding.

Young budding was carried out in September on stock plants having a minimum diameter of around 4 mm at the base. For budding on young stocks, the budding panel is opened by stripping up a patch of bark of about 3 cm x 0.5 cm size at a height of 2 cm from the collar region. The strip is peeled leaving a flap of about one cm. Bud patches were removed from the bud stick by stripping it carefully. Bud patch is trimmed to a size little smaller than the budding panel and is inserted under the flap gently. A firm binding is made with a transparent polythene. Polythene tape measuring 15 cm x 1 cm and thickness of 0.05 mm which has been found to be most suitable for young buddings.

Four weeks after budgrafting the stocks were cut back at 7.5 cm above the bud patch following the removal of polythene one week before. Pruning of stock shoots were done as soon as it emerged out to allow the scion shoot to develop fast.

Control plants were raised in the ground nursery prepared by digging the soil to a depth of about 75 cm removing stones and root debris. Germinated seeds were planted in early August at a distance of 30 cm x 30 cm and the plants were nursed carefully by adopting the recommended cultural operations. Plants were budgrafted in January after 5 months of age with green buds taken from eight weeks old bud shoot. Successful grafts were cut back four weeks after budding and transplanted into the already filled polybags. All the normal agro management practices recommended for the bag plants were followed upto May.

Height and diameter of the stocks seedlings were measured just before budgrafting. Buddability of stocks seedlings was assessed at the time of budgrafting and budding success was recorded at the time of cutting back. Sprouting of successfully budded plants following cutting back was recorded at weekly intervals. As die back of the scion was noted, mostly at one whorl of leaves stage weekly spraying of 1.0% urea was carried out to enhance growth of the scion.

Survival rate and recovery of usable plants with 2-3 whorls was enumerated in May. Simultaneously the scion growth in terms of height, number of whorls and diameter were recorded. The data was subjected to statistical analysis for comparison with the conventional method of green budding.

Results and Discussion

The frequency curve for the diameter of stock plants in the polybags of each treatment at the time of budgrafting is shown in Fig. 1. Diameter of seedlings grown for 6, 7 and 8 weeks increased during the period and showed a normal distribution with a distinct shift of the curve from six to eight weeks. Diameter of substantial populations of each of the group was almost uniform which fall in the class interval of 4.0- 4.5 mm, 4.5 – 5.0 mm and 5.0 – 5.5 mm respectively. Plants grown in the ground nursery for the green budding showed a mean diameter of only 5.8 mm at five months growth stage ranging from 3.5 — 8.0 mm and diameter of about 30% of the total population was below the required minimum of around 7.5 mm. Higher variability was observed among the plants in the ground nursery, probably as a result of competition between the plants for space, light, and nutrients as they were five months old. In the case of seedlings in the bags, which were grown only upto eight weeks age, competition has not set in and hence exhibited more uniformity coupled with vigorous growth. Apart from this, other micro environmental features are also different for ground and polybag nurseries (Seneviratne *et al.*, 1996).

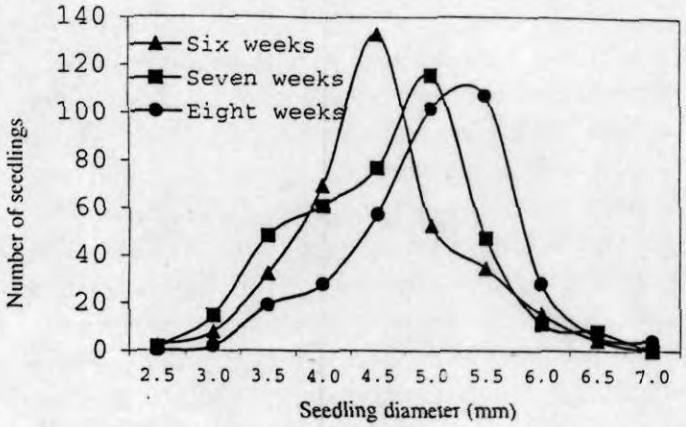

Fig. 1. Frequency curve for diameter of seedling population raised in polybags

Young budding was carried out on stocks at all stages of growth of the top flush of leaves. In young seedlings peeling quality was not affected by immature flushes. The percentage buddability of 6, 7, 8 weeks old seedlings and budding success were scored as shown in Table 1. It is observed that among the three treatments, number of buddable plants were lowest in stock population aged six weeks and highest in that of eight weeks and the difference was highly significant. Low buddability of six weeks old stock is probably due to its smaller size and tender nature, which caused difficulty in the handling of stock plants at the time of bud grafting. However, a higher percentage of stocks were available for young budding purpose at a time compared to green budding. Owing to higher peelability, uniformly growing young stock seedlings for young budding recorded a higher percentage of buddability compared to stocks for green budding aged five months.

Table 1. Buddable plants and budding success of young and green budded grafts

Age of stock seedlings	Buddable plants (%) 1998	1999	2000	Mean	Budding success at cut back (%) 1998	1999	2000	Mean
Young budding								
6 weeks	66.61	71.8	66.9	68.42	58.8	61.1	56.22	58.75
7 weeks	80.70	83.2	72.9	78.91	76.9	81.3	77.28	78.46
8 weeks	86.55	86.9	85.5	86.34	83.3	83.3	85.33	83.91
Green budding	64.04	72.0	70.0	68.83	88.1	87.8	90.60	88.94
CD (P=0.05)	4.73	5.35	3.73	3.32	3.25	3.17	2.96	2.33

The budding success was scored at the time of cutting back four weeks after budding. Success on stocks of eight weeks old was comparable with green budding though the difference was significant. However, low budding success was encountered on very young stocks of six weeks old. If the stem of the stock is very immature, budding procedure allows for chances of injury to the tender green tissues easily. Budding success of about 84% on eight week old stock can be considered satisfactory as none of the budders had previous experience with young budding technique. In earlier reports (Leong & Yoon, 1985) budding success of 95% has been confirmed for young budding on stock aged two months.

Successful budgrafted plants were cut back at a height of 7.5 cm above the bud patch. For typical young budding, a long snag of about 20 to 25 cm is left behind. In one of our earlier experiments, it was observed that with longer snags sprouting gets delayed and become very uneven. This has been reported earlier also (Seneviratne et al., 1994, 1996). Moreover, long snag left behind caused necessity for pruning of stock shoots very frequently (Leong and Yoon,1985). On account of this, a short snag is left behind at the time of cutting back.

All the stock shoots were removed as soon as they emerged. The buds sprouted seven to ten days after cutting back. In general, percentage of sprouting in all the treatments was uniform and good. However, survival rate was found to be low (Table 2) in young budding since before the first whorl of leaves matured severe die back of scion shoots was encountered in young budding compared to green budding in spite of having a better developed root system. The final percentage of recovery of usable plants from the stocks budded and over successful bud grafting was significantly higher in green budding than in young budding (Table 3). Pooled data showed that green budding gave more than 75% and 85% recovery of polybag plants over original number of stocks and successful budgrafted plants respectively while in the young budding done even on stock aged two months, the percentage was 42.70 and 50.43 respectively. This may be due to the exhaustion of the reserve food in young buddings before the leaves attain full maturity for the required photosynthetic efficiency. Once the leaves of first whorl of scion mature, the plants mostly survive. Die back was found to be the highest in the youngest stock. Small size of the stocks and scion with very little reserve food is also attributed as suggested by Hurov (1960) and RRIM (1964). Comparatively low incidence of die back observed in the case of green buddings, which are larger in size, compared to young buddings supports this presumption. Thus, percentage of recovery of usable bag plants in the nursery was more in the case of green budding resulting in less wastage of bags compared to young budded plants. There was a positive correlation between diameter of the stock at bud grafting and diameter ($r = 0.834$) and height ($r = 0.794$) of the scion at the time of field planting indicating that more vigorous stock has a beneficial effect on the growth of the scion in the initial period. Vigorous scion was produced by using vigorous stocks for bud grafting. Tiong and Kheng (1988) have also shown that there is correlation between

height of scion and diameter of stock for different types of planting materials including young budding. They strongly recommended an intensive selection of root stocks before budgrafting for further vigourous growth of scions.

Table 2. Survival percentage of young and green budded grafts

Age of stock seedlings	Survival percentage			
	1998	1999	2000	Mean
Young budding				
6 weeks	44.40	47.52	55.30	49.08
7 weeks	44.54	50.55	54.02	49.72
8 weeks	51.40	51.51	52.31	52.04
Green budding	93.40	93.60	92.08	93.04
CD (P=0.05)	8.28	8.41	9.31	4.62

Table 3. Recovery of usable bag plants in young and green budded grafts

Age of stock seedlings	Usable plants over original number of stocks (%)				Usable plants over successful budgrafted plants (%)			
	1998	1999	2000	Mean	1998	1999	2000	Mean
Young budding								
6 weeks	31.14	33.71	33.14	32.60	40.87	42.48	47.33	43.72
7 weeks	38.24	40.00	40.57	39.61	42.59	45.33	49.75	46.10
8 weeks	40.28	42.25	45.50	42.70	49.20	51.31	50.78	50.43
Green budding	78.00	80.00	76.00	78.96	85.00	84.90	88.88	86.26
CD (P=0.05)	4.12	2.89	2.73	1.10	2.48	1.46	2.20	1.80

Height, diameter and number of leaf whorls of the scions were recorded in May, seven months after cutting back in October. Differences in mean scion growth of young and green budding on the stocks sown in August over the three experiments is shown in the Table 4. Analysis of the pooled data revealed the superiority of young budding regarding growth in the nursery stage. Differences in growth were significant for the two types of buddings except diameter. After initial small flushes scion growth on young stock was at a rate similar to that of green budding. Therefore, earlier buddings (young buddings), though survival rate was less, maintained their lead in growth in the nursery as evidenced from increased number of whorls and height. Young budded plants produced an average of 3-4 whorls of leaves by the month of May while green buddings have 2-3 whorls by this time. Simultaneously mean height of the scion in young budded polybag plants was higher compared to green budded polybag plants.

Young budding has a short production cycle compared to other conventional budding methods (Leong and Yoon 1985; Tiong and Kheng, 1988). Once the stock plant is cut back, after budgrafting, the scion bud starts growing and within a period of four months, the survived plants are ready for transplanting into the field. Thus bag plants with two- three whorls of leaves could be produced within seven months after planting of germinated seeds in the bags, which is usually done in August/September in India. Young buddings, which were cut back at the end of October get seven months growth, whereas green buddings cut back in the first week of February could grow only for four months. When the bag plants produced by young buddings attain two- three whorls of leaves in February, the climate is unfavorable for field planting. Therefore, planting has to be delayed till the onset of monsoon in June and the plants have to be maintained in the nursery up to that time resulting in overgrowth of plants and increased nursery maintenance cost. Bag plants with 2-3 whorls of leaves produced by green buddings are also become ready for field planting by June with higher percentage of recovery of usable bag plants (Marattukulam and Mercykutty, 2000). So, under the climatic conditions existing in our country, typical young budding does not have much practical application. At present some nursery owners in our country adopt a slightly modified schedule for the production of young budded plants (Kuriakose, 2002). Under this practice, budding is done on eight weeks old plants as usual and cutting back is done 5-6 months after budding in February/March. These plants will produce two- three whorls of leaves by June/July.

Malaysia recommends young buddings as a superior planting material, mainly due to two favourable factors existing in that country. One is the availability of seeds during two seasons (February and August) which enables two rounds of production of young budded plants. The prevailing two planting seasons viz., spring (April) and autumn (October) is the other factor. Young budded plants raised from seeds collected during September and March can be planted in April and October respectively. However, under the climatic conditions existing in India for successful production of young buddings, proper

Table 4. Height, number of whorls and diameter of young and green budded grafted plants

Age of stock seedlings	Height (cm)				No. of whorls				Diameter (mm)			
	1998	1999	2000	Mean	1998	1999	2000	Mean	1998	1999	2000	Mean
Young budding												
6 weeks	25.23	23.42	27.72	26.78	3.51	3.62	3.62	3.57	5.31	5.31	5.42	5.30
7 weeks	27.31	36.31	29.34	31.10	3.90	3.91	3.81	3.86	5.73	5.82	5.64	5.71
8 weeks	28.00	30.49	28.67	29.11	4.00	4.00	3.92	3.96	5.35	5.75	5.42	5.49
Green budding	18.68	19.91	19.54	19.36	2.01	2.11	2.22	2.11	5.80	5.00	4.92	5.18
CD(P=0.05)	1.04	6.35	1.71	0.49	0.19	0.32	0.24	0.05	NS	NS	NS	NS

planning and better management practices throughout the nursery period is essential.

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References

Dijkman, M.J. 1951. *Hevea* : Thirty years of research in the Far East. University of Miami Press, Florida, p. 329.

Hurov, H.R. 1960. Green bud strip budding of two to eight month old rubber seedlings. *Proc. Natural Rubber Conf.*, 1960, Kuala Lumpur, p. 419.

Marattukalam, J.G. and Mercykutty, V.C. 2000. Propagation techniques. In: *Natural Rubber: Agromanagement and Crop Processing*. (Eds. P.J. George and C. Kuruvilla Jacob). *Rubber Research Institute of India*, Rubber Board, Kottayam pp.75-96.

Kuriakose, K.C. 2002. Young budding: A new propagation technique in Rubber. *Rubber Planters Conf., India*, 21-22 November 2002, Kottayam, India. pp. 132-135.

Leong, S.K. and Yoon, P.K. 1985. Use of young budding for improved *Hevea* cultivation. *Proc. Internat. Rubber Conf.*, Kuala Lumpur. pp. 555-557.

Ng, K.F., Vanaja, V., Chin, S.L. and Arshad, N.L. 1991. Promoting young budding and speculative clones to the smallholder sector. *Proc. Rubber Res. Inst. of Malaysia, Rubber Growers' Conference*, Kuala Lumpur, Malaysia, pp.67-94.

Ong, T.S., Heh, Wy and Wong, C.P. 1989. Young budding – commercial experience in a large plantaion group. *Proc. Rubber Growers Conf.*, pp.110-134.

RRIM, 1964. Some notes on green budding. *Planters Bulletin*, **72** : 49-53.

Seneviratne, P. 1995. Young budding – A better planting material. *Bulletin of RRISL*, **32** (1): 35-38.

Seneviratne, P., Nugawela, A., Samarakoon, S.M.A. 1994. Factors affecting the bud grafing success and the scion growth of *Hevea*. *J. Rubber Res. Inst. Sri Lanka*, **74**: 38-54.

Seneviratne, P., Nugawwala, A., Samara Koon, S.M.A. and Ramawickkrama D.1996. The growth of stock plants and its effect on the sum growth of young buddings of *Hevea brasiliensis* (Muell Arg.). *J. Plant. Crops* **24**(2): 119-125.

Tiong, G.L. and Kheng, C.O. 1988. Experience with the young budding techniques in rubber. *The Planter, Kuala Lumpur*, **64**: 439-451.