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FIELD PERFORMANCE OF *HEVEA* TREES RAISED THROUGH UNCONVENTIONAL NURSERY TECHNIQUES

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In a study on the effect of nursery practices on growth and yield of *Hevea brasiliensis* trees it was observed that the field performance of bench-grafted plants is comparable to that of nursery grafted plants. The practice of high budding and different methods of deep planting had no influence on growth of budded stumps in the field. Polybag plants exhibited superiority in growth over budded stumps during the initial stages. There was no uprooting of plants irrespective of the treatments.

Key words: Bench-grafting, Budding, Deep planting, Field performance, *Hevea brasiliensis*.

Rubber (*Hevea brasiliensis)* plantations are normally raised from high yielding clonal material propagated by bud grafting. *In situ* grafting using a bud patch on stocks growing in a ground nursery is the widely followed method of propagation. A variant of this technique called bench-grafting is practiced in *Citrus* (Mahlstede and Haber, 1966); pine, *Magnolia*, oak, *Rhododendron* (Macdonald, 1986); *Picea* (Macdonald, 1990); walnut (Bhat *et al.*, 2000; Solar *et. al.*, 2001) and grapevine (Rezende *et al.*, 2001). It is a grafting method performed on a work-bench inside covered structures (Mahlstede and Haber, 1966; Macdonald, 1986). For this, stock plants are removed from the soil and budding is carried out indoors. This is usually adopted under adverse climatic conditions for outdoor grafting such as severe cold, extreme summer and heavy rains. Bench-grafting of brown buds of five popular rubber clones on ten month-old stock plants (Marattukalam and Varghese, 1993), and green buds of the clone RRII 105 on six month-old stock seedlings (Marattukalam and Varghese, 2000), has been successfully performed on *Hevea brasiliensis.*

In the normal budgrafting procedure, budding is carried out just above the collar region of the stock plant and during planting, very little stem of stock is buried in the soil. It is reported that if budding is carried out at a higher level and a longer portion of the stock stem is buried in the soil while planting, the plants develop additional roots from that region, resulting in more transplanting success, vigorous growth in the initial months and better anchorage (Yoon and Ooi, 1976; Yoon and Ooi, 1978; Nair, 1983; Yoon *et al.*, 1985; Tiong and Kheng, 1987). In such studies, the buried taproot

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had the standard recommended length. When high budded-stumps are planted, their buried stem increases the length of the total buried portion. Whether the better performance of the high-budded plants was exclusively due to the burying of stem or due to the higher length of the plant parts buried in the soil was not clearly evident from these studies. The reports on high-budded and deep planted trees confine to their better performance in the initial years and not up to tapping stage or beyond. Therefore, two experiments were carried out one with the objective of studying the long term field performance of rubber trees raised from bench grafted plants in comparison with nursery grafts and the other to compare the field performance of high-budded and deep-planted plants with plants budded and planted following the standard method.

In the first experiment, performance of plants raised by bench and nursery grafting methods was studied. The scion clones included in this study were RRII 105, RRII 118, RRII 203, RRII 208 and GT 1. Budding was carried out using brown buds and field planting was done following randomized block design of three replications, each with nine trees under square planting at 4.9 x 4.9 m spacing. The package of practices recommended for the traditional rubber growing region of India was followed (Potty *et al.*, 1980; Pushpadas and Ahammed, 1980; Punnoose *et al.*, 2000). Observations on casualty, girth and yield were recorded. Girth measurements were made annually at a height of 150 cm above the bud union from the fourth year onwards. The trees were opened for tapping eight years after planting and 1/2S d/2 6d/7 system of tapping was followed. During the first five years of tapping, yield was recorded monthly by cup-coagulation method.

In the second experiment, performance of plants raised by the high-budding method and deep-planted in the field pits was compared with normally prepared budded stumps and polybag plants planted at normal depth. The clone used for this experiment was PB 260. High-budded plants with tap-roots of normal and shorter length were used so that the buried portion was equal in length in all the treatments. Treatments included in the study are given in Table 1. The field trial was laid out following a randomized block design with four replications each of 25 plants planted at 6.70 x 3.35 m spacing. Polybag plants with two whorls of leaves having a mean height of 75 cm were used as control. Recommended package of cultural practices were adopted. Data on height of plants after one year, casualty during the first year and every year were recorded from third year onwards up to 17 years.

Table 1. **Treatment details of the experiment on high-budding and deep-planting**

Treatment No.	Height of budding	Length of buried portion (cm) Stock stem	Tap root	Total
T_1	Normal	0	60	60
T_2	15 cm	15	45	60
T_3	30 cm	30	30	60
T_4	45 cm	45	15	60
T_5	Normal	0	45	45
T_6	Control*	0	38*	38**

*Polybag plants; **At the time of planting in polybags

The data on growth and yield of plants in the first experiment are given in Table 2. Girth at fourth year after planting ranged from 16.4 cm (RRII 208 bench-grafts) to 25.2 cm (RRII 203 bench-grafts). Girth at

Table 2. **Growth* and yield of bench-grafted and nursery plants**

Clone	Girth at fourth year (cm)		Girth at opening (cm)		Annual girth increment on tapping over 5 years (cm)		Girth at 14 years (cm)		Annual yield over 5 years (g/t/t)	
	BG	NG	BG	NG	BG	NG	BG	NG	BG	NG
RRII 105	18.4	16.8	51.9	50.3	3.1	2.9	67.5	64.6	48.5	42.9
RRII 118	25.0	23.4	63.6	57.2	4.2	3.6	84.6	75.2	36.5	32.9
RRII 203	25.2	21.4	60.7	59.5	3.8	3.7	79.7	78.0	39.3	40.9
RRII 208	16.4	16.9	46.7	52.2	3.0	3.2	61.8	68.1	33.1	38.9
GT 1	20.6	21.3	50.8	53.3	3.4	3.6	67.6	71.3	34.2	32.3
Mean	21.1	20.0	54.8	54.5	3.5	3.4	72.2	71.5	38.3	37.6
C.V (%)	12.9	12.9	6.00	6.0	10.1	10.1	4.5	4.5	10.2	10.2
C.D. (0.05)	4.6	4.6	5.60	5.6	0.6	0.6	5.5	5.5	6.6	6.6

BG – Bench-graft; NG - Nursery-graft *Values are mean of three replications

opening was the highest in RRII 118 bench-grafts (63.6 cm) and the lowest for RRII 208 bench-grafts (46.7 cm). Girth at 14 years after planting was the maximum in RRII 118 bench-grafts (84.6 cm) and the minimum in RRII 208 bench-grafts (61.8 cm). Girth increment on tapping for five years ranged from 2.9 cm in RRII 105 nursery grafts to 4.2 cm in RRII 118 bench-grafts. Similarly mean yield over the first five years of tapping was the highest for RRII 105 bench-grafts (48.5 g/t/t) and the lowest for GT 1 nursery grafts (32.3 g/t/t). Data revealed clonal differences in response to the grafting (budding) methods. Vigorous clones like RRII 118 and RRII 203 exhibited significantly better growth when compared to the other clones in all phases of growth irrespective of the grafting method. Similarly the high yielding clone RRII 105 gave significantly higher yield in both types of grafts. There was no appreciable difference in yield between plants raised by the two methods. This clearly shows that both growth and yield of *H. brasiliensis* trees are not influenced by the grafting technique adopted in the nursery. From the results it can be concluded that bench grafting of *H. brasiliensis* under adverse climatic conditions is feasible.

A summary of the data on casualty and growth of plants in Experiment II is presented in Table 3. There was no significant difference between treatments regarding casualty during the first year though it was minimum (3%) in the case of polybag plants and varied from 11 to 19 per cent in other treatments. The polybag plants had attained a height of 276.2 cm after one year and was found to be significantly superior to all the other treatments. The other treatments had no significant difference in height of plants. Girth of the plants recorded three years after planting had the same trend. Polybag plants with a girth of 16.9 cm showed significant superiority over the other treatments, which exhibited no significant difference. Girth of the polybag plants was significantly superior to all the treatments except for T_4. Mean annual girth increment after the commencement of tapping indicated that the polybag plants were significantly inferior to plants under the treatments of T_3, T_4 and T_5 and were on par with T_1 and T_2. The girth of the trees recorded at the age of 17

Table 3. **Growth* of trees raised from high-budding and deep-planting**

Treatment	Casualty after one year (%)	Height after one year (cm)	Girth after 3 years (cm)	Girth at opening (cm)	Annual girth increment (cm)	Girth at 17 years (cm)
T_1	16	137.6	13.6	43.8	2.5	68.3
T_2	12	138.4	13.3	43.2	2.6	69.4
T_3	11	135.4	13.9	43.4	2.8	71.7
T_4	19	135.3	13.5	45.1	2.8	73.1
T_5	17	128.5	13.0	43.3	2.9	72.7
T_6	3	276.2	16.9	47.7	2.4	71.6
C.V (%)	38	8.7	7.4	4.5	8.6	4.8
C.D. (0.05)	NS	20.8	1.6	3.0	0.3	NS

* values are mean of four replications

years did not indicate any significant difference among various treatments.

The study indicated that the growth of budded stumps in the field was not significantly affected by height of budding or variation in the length of the buried tap root and/or stock stem. Polybag plants exhibited some superiority in growth over budded stumps in the initial stages, which gradually diminished with age. At the time of the commencement of tapping, polybag plants were superior to plants in other treatments except T_4. But the girth increment after the commencement of tapping was lower for polybag plants and was significantly inferior to three other treatments. As a result of this after 17 years, there was no significant difference in girth among the treatments. No incidence of uprooting was noticed in any of the treatments indicating that the differences in the length of stock stem and taproot have no bearing on root anchorage.

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