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METHODS TO IMPROVE ESTABLISHMENT SUCCESS AND GROWTH OF GREEN BUDDED STUMPS OF *HEVEA* IN POLYBAGS

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Studies were undertaken in the polybag nursery for two successive years to investigate whether indole butric acid (IBA) and water enhanced establishment of green budded stumps of *Hevea* in polybags. Three different concentrations *viz*. 250 ppm, 500ppm and 1000 ppm IBA were used for the study. A simple technique of keeping tap root of green budded stumps dipped in fresh water for 4-5 hours before planting in polybags was also attempted. Examination of the stumps after four months from application showed that IBA at 500 ppm and water gave 73.16 % and 66.27% establishment, respectively whereas it was 53.50% in the control. IBA at the concentration of 500 ppm and also fresh water treated stumps recorded better height, diameter, and number of whorls than the untreated stumps. Dry weight of lateral roots showed better response of 138% (500 ppm IBA) and 125% (fresh water) over the control. The results of this study indicated higher production of lateral roots after the IBA and water treatments and thereby better establishment of green budded stumps in polybags.

Keywords: Green budding, Growth of *Hevea,* IBA and Water

INTRODUCTION

The green budding technique on root-stock of five to six months old is the most commonly practised propagation method in *Hevea.* Optimum time for green budding is the dry months from January to March in the traditional rubber growing regions in India. It has been observed that green budded stumps when planted in polybags often showed high percentage of casualty due to dieback of the scion (RRIM, 1964; Marattukalam and Varghese, 2000). Some of the causes for the dieback of green budded stumps were the delay in initiation of lateral roots due to progressive desiccation of stumps and low carbohydrate reserve (Hafsah and Pakianathan, 1979). Delayed planting of green budded stumps in polybags causes further desiccation and reduces viability of the stumps due to water loss (Pakianathan and Tharmalingam, 1982). To overcome such adverse situations, methods were tested to improve the establishment success in polybags by inducing early rooting and prevent desiccation. The objectives of the study were to determine the optimum concentration of indole butric acid (IBA), a rooting hormone widely used in horticultural nurseries to

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stimulate root initiation for better establishment of plants and to test the effectiveness of dipping tap root of green budded stumps for a period of four to five hours in water before planting in polybags in order to overcome desiccation.

MATERIALS AND METHODS

Vigorously growing seedlings having a collar diameter of about 0.75cm ± 0.12cm were used as root-stock plants for producing green budded stumps. The stumps used in the experiment were from assorted seedling stock of 5-6 months age. They were bud grafted with the clone RRII 105 during February. Ten days after removing the polythene strips, uprooted budded seedlings were cut back at a height of 7.5 cm above the bud patch. The tap root of each stump was slant cut at about 35 cm below the collar. Cut end of the stem was sealed by dipping in melted wax. The lateral roots were trimmed to give a fresh end to enable the absorption of IBA and water.

Preparation of IBA formulation

Refined china clay (1 kg) was made into slurry with 50% commercial alcohol. IBA (1 g) was dissolved in 10 ml absolute alcohol and added to the slurry to give an overall concentration of 1000 ppm. The slurry was stirred well for 5-6 minutes to ensure complete solubilization of IBA. The alcohol ensured solubility and absorption of IBA by china clay. IBA concentrations of 250 and 500 ppm were also prepared by following the same procedure. The tap root was dipped into the slurry and excess slurry was drained off. The treated stumps were dried for 15 minutes under shade and transplanted into polybags. For water treatment, taproots of budded stumps were kept dipped in a bucket containing fresh water for four to five hours before planting into the polybags. The control plants were pulled out from the nursery, and planted without any treatment.

The polybag nursery experiment was laid out at Central Experiment Station, Chethakal in completely randomized design (CRD) with 40 replications of single plants during March. All the plants were maintained in the polybag nursery adopting standard recommended cultural operations (Potty, 1980; Marattukalam *et al*., 1980). Plants were grown maintaining optimum soil moisture and provided 50% shade with agro-shade net. Four months after transplanting, success of the plants established in the poly bags as well as growth characters such as plant height, basal diameter and number of leaf whorls were recorded. The dry weight of lateral roots at the end of the experiment was also recorded. The study was repeated over two consecutive years during 2007 and 2008. The data was analyzed statistically for test of significance.

RESULTS AND DISCUSSION

Among the three concentrations, 500 ppm IBA was very effective for the development of roots. Mean values over two years of the study showed that treatment of green budded stumps with 500 ppm IBA recorded the highest establishment success of 73.16% in comparison to the control (53.50%) (Table 1). Plant growth regulators have been reported to enhance physiological activities like cell division, cell elongation, photosynthesis and translocation of nutrients and photosynthates (Saxena, 1989). They are also known to increase agricultural

Table 1. **Effect of IBA and water on establishment success of plants**

Treatment	Establishment success (%)		
	2007	2008	Mean over two years
IBA 250 ppm	67.55	50.00	58.78
IBA 500 ppm	75.82	70.50	73.16
IBA 1000 ppm	67.53	59.50	63.52
Water	64.54	68.00	66.27
Control	52.00	55.00	53.50
CD (P=0.05)	7.90	5.26	-
S.E	5.13	1.81	-
CV	9.45	8.55	-

production and help in removing barriers imposed by genetics and environment (Nickell, 1982; Mishra, 1989).

Lower survival of the stumps was noticed when treated with 1000 ppm IBA possibly due to lethality with higher IBA concentration. Low concentration of 250 ppm IBA was not so effective for better establishment of plants in the polybags. Hafsah and Pakianathan (1979) favored higher concentration of 2000 ppm IBA for inducing root growth and better survival of the root stocks of six to seven months age with a mean diameter of 1.25cm. In the present case, root stocks were five month old and had a mean diameter of about 0.75cm and showed inhibitory effects after treating with higher concentration of IBA as judged from the reduction in sprouting and establishment of rubber plants in poly bags. Budded stumps with variation in girth and age differed in their response to IBA. Younger stumps were more sensitive to higher concentrations of IBA. Pakianathan *et al.* (1979) also opined that optimum concentration of IBA for rooting of budded stumps depends on the age and size of root stock seedlings. Vanangamudi *et al*. (2008) reported that cuttings from varieties within a species even from individual plants of the same variety may vary considerably in rooting response to hormones.

Dipping the tap root of stumps in water significantly increased the establishment rate of plants (66.27%) compared to the control plants (53.50%). One of the main reasons for the failure in establishment was excessive water loss in plants before planting. Absorption of water prevents desiccation and promotes root initiation. High atmospheric temperature of 36-38 ^{o}C prevailing in the season in which green budded stumps were uprooted might be an important factor for desiccation and rooting response for green budded stumps. Any environmental stresses such as high temperature/drought could affect adversely the growth of scion. During such conditions low RH and high ambient temperatures could increase the evapo-transpiration of the scion exponentially (Kramer and Boyer, 1995). Effects of drought could be avoided by keeping the taproot dipped for a minimum period of four to five hours in water before transplanting the plants into polybags that are kept under shade for maintaining optimum soil moisture. For overnight storage, keeping brown budded stumps dipped erect in water was found to be effective in maintaining its freshness (Marattukalam and Mercykutty, 2000). The advantage of water storage is more apparent in relation to viability when planting is done under adverse weather conditions.

In general, growth of plants treated with 500 ppm IBA and fresh water were superior with a mean height of about 25.31 cm and

Table 2. **Effect of IBA and water on height and diameter of plants**

Treatment	Height (cm)			Diameter (mm)		
	2007	2008	Mean	2007	2008	Mean
IBA 250 ppm	18.82	23.15	20.98	5.15	5.43	5.29
IBA 500 ppm	22.7	27.92	25.31	5.45	5.52	5.48
IBA 1000 ppm	19.73	19.81	19.77	4.92	5.11	5.01
Water	20.54	22.44	21.49	5.17	5.12	5.15
Control	18.15	20.73	19.44	5	4.62	5.06
CD(P = 0.05)	NS	6.77		0.37	0.41	-
SE	1.15	2.04		0.12	0.14	
CV	11.51	17.92		4.66	5.23	

Table 3**. Effect of IBA and water on number of whorls and lateral root dry weight**

Treatment	No. of whorls			Lateral root dry weight(g)		
	2007	2008	Mean	2007	2008	Mean
IBA 250 ppm	1.43	1.77	1.6	4.02	5.07	4.54
IBA 500 ppm	2.3	2.07	2.18	5.98	5.92	5.95
IBA 1000 ppm	1.62	1.9	176	4.48	5.25	4.86
Water	1.92	1.91	1.91	6.04	4.4	5.22
Control	1.52	1.67	1.59	3.87	3.51	3.69
CD(P= 0.05)	0.42	0.23		0.96	1.33	
SE	0.14	0.75		0.32	0.44	
CV	16.02	8.09		14.97	18.07	

21.49 cm respectively (Tables 2 & 3). Mean height of scion in the untreated control plants was 19.44 cm and the difference was significant during the year 2008.

Significant increase in the diameter of plants coupled with increase in number of whorls was noted in the treated plants as compared to the control. The use of plant growth regulators not only helped in frame formation but also ensured faster growth of the plants resulting in the production of vigorous plants (Manivel, 1994). The improvement of scion height in treated plants, though not significant, indicated initial advantage of establishment after treatment and such plants maintained better growth subsequently till four months.

There was an improvement in dry weight of lateral roots in all the treated plants. Generally IBA treatments gave higher root production and better dry matter production. IBA supplement auxin a naturally occurring plant hormone that is responsible for root development. Hafsah and Pakianathan (1977) screening a number of growth substances for root promoting activity in *Hevea* showed that IBA was active in inducing lateral roots in budded stumps. Plants treated with 500 ppm IBA recorded better dry root weight of 5.95 gm followed

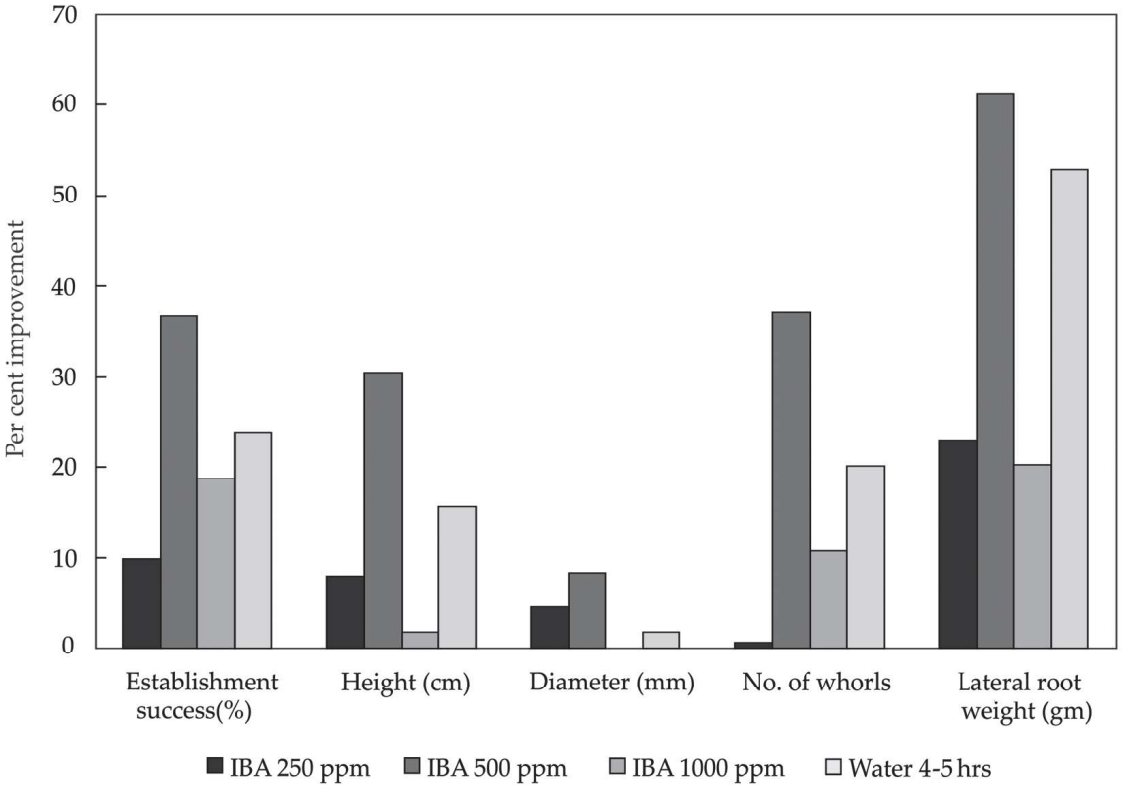

Fig. 1. Per cent improvement of growth parameters over control

by plants raised from stumps kept dipped in water (5.22gm). Untreated plants recorded an average dry weight of 3.69gm. The stumps treated with 1000 ppm showed marginal reduction in root length. Application of 250 ppm IBA gave mild rooting response. In general, the overall dry matter production of roots at the end of the experiment was higher in treated plants than the control. Growth substances which are auxenic in nature, promote initiation of roots which will usually initiate a crop of laterals and better survival (Torrey, 1950). Treatment at 500 ppm IBA could induce a response of 138% and water treatment gave a response of 125% root growth of the control (Fig. 1).

The present investigation clearly establishes the efficacy of treating green budded stumps with 500 ppm IBA and keeping tap root of stumps in fresh water for a certain period of time before planting in polybags for better establishment and accelerated hardening of first whorl leaves. Normally, the initial two months after transplanting are critical for the survival of the stumps if the weather is unfavorable. Since green budded stumps are comparatively tender and smaller with less reserve food, it is always preferable to plant them immediately after pulling out from the field by providing water and shade. The simple method of keeping the tap root of green budded stumps dipped in fresh water was found to be effective and promising for better establishment in polybags and this could be recommended for adoption.

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