ENHANCEMENT OF BUD SPROUTING AND GROWTH OF GRAFTED RUBBER *(HEVEA BRASILIENSIS)* PLANTS UTILISING A POLYHOUSE DURING WINTER IN TRIPURA

Krishna Das, Debabrata Ray and Sushil Kumar Dey

Regional Research Station, Rubber Research Institute of India,
Kunjaban - 799 006, Agartala, Tripura, India

Das, K., Ray, D. and Dey, S.K. (2009). Enhancement of bud sprouting and growth of grafted rubber (*Hevea brasiliensis*) plants utilising a polyhouse during winter in Tripura. *Natural Rubber Research*, **22** (1&2): 163-167.

Winter season (November to February) in Tripura is not conducive for bud sprouting in grafted stumps of natural rubber *(Hevea brasiliensis)* as the minimum temperature often goes below 15 °C during these months. Low temperature during winter inhibits bud sprouting and delays plant growth. To overcome this, the present experiment was designed with bud-grafted stumps grown inside a polyhouse. Regular water spray on the bud patches and soil irrigation were also provided. A much higher temperature than the open ambient air could be maintained in the polyhouse. Due to the effect of polyhouse, evaporation loss was less and hence, a more humid condition was achieved inside. The high temperature and humidity conditions were congenial for better bud sprouting and eventually raising healthy seedlings. Using this simple technique, growers of this region can utilise the winter months also and generate healthy planting materials throughout the year.

Keywords: Budded stumps, Cold, Polyhouse, Relative humidity, Sprouting, Temperature.

Natural rubber *(Hevea brasiliensis)* is traditionally grown in Kerala and in the Kanyakumari district of Tamil Nadu where winter is not severe. Scope for expansion of rubber cultivation in these areas is limited and therefore the increasing demand for natural rubber in India can only be met by expanding rubber cultivation in North East (NE) India. Suitability of the crop to the terrain and its acceptability amongst the local people make rubber cultivation attractive in the NE region, particularly in Tripura. Although this region lies far outside the traditional rubber growing zone, the agroclimatic conditions are unique, as near-tropical conditions are experienced in most parts of the region owing to elevations, exposure to monsoons and other moderating influences. However, agroclimatic conditions in this part of the country differ from that in the traditional belt. There is extremely low temperature during the winter months (November–February) in Tripura. This low temperature affects bud sprouting in grafted plants and results in poor and delayed growth of plants. Hence, winter season is not suitable for generating planting materials of rubber in this region.

Considering the excellent potential for rubber cultivation in this region, emphasis

Correspondence: Krishna Das (Email: krishnadas@rubberboard.org.in)

has been given to increase the area under rubber by starting new plantations and replanting the old areas. Consequently, the demand for planting materials has increased. In Tripura, bud-grafting in rubber is usually done between June and August. To meet the increasing demand for planting materials for extensive rubber cultivation, it is necessary to take up budding and allied activities even during winter period so that the planting materials are ready with the onset of monsoon. However, winter season is not conducive for plant growth and development under open field conditions. The present experiment was done to assess sprouting rate in different months and accelerating bud sprouting during the winter season by growing plants under optimum temperature and humidity conditions inside a polyhouse, with regular spraying of water on bud patches of the budded stumps.

The temporal variability in bud sprouting in different months was studied in a set of 20 budded stumps planted in poly bags in the first week of every month from July to March. The clone RRIM 600 was used. The plants were given normal irrigation schedule. However, no additional care such as use of moist cotton on the bud patch was given. Sprouting percentage and other growth parameters were recorded from these stumps. The experiment was carried out for two consecutive years.

For the experiment on increasing bud sprouting and growth during winter, the clone RRIM 600 was bud-grafted during October. The polythene strips on the bud union were removed six weeks after grafting. Every month from November to March when the temperature was below 15 °C, successfully budded stocks were pulled out from the soil, cut back 7.5 cm above the bud union and planted in polybags. Five polyhouses were made, each having a size of 5x3x3 ft, covered completely from all sides with thick transparent polythene sheets. Twenty stumps planted in polybags were placed inside each polyhouse. Another set of bud-grafted stumps planted in polybags in five replications was kept outside in the open. Randomised block design was adopted. Bud patches of all stumps placed inside and outside the enclosure were covered with a thin layer of cotton and sprayed with water once daily till the emergence of the sprout. Cotton layers were removed soon after the bud sprouted. Plants were irrigated once in three days. The minimum and maximum temperatures were recorded daily in each polyhouse as well as in the open area. Observations on sprout emergence commenced one week after the polybag planting, and further growth was recorded weekly. The polythene sheets of the enclosures were removed by the end of the second week of March when the minimum temperature rose above 15 °C. Girth, height and number of whorls were recorded from both the sets of plants at the end of June.

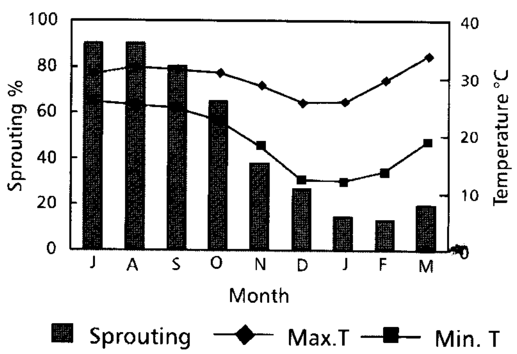

Fig. 1. Sprouting of budded stumps under normal conditions

The experiment on the effect of planting month (July-March) on sprouting in plants grown in the open showed that sprouting percentage reduced gradually with decline in temperature during the winter months (November–February), even with regular irrigation (Fig. 1). Minimum temperature was found to have a greater effect on sprouting than maximum temperature. This supports the findings of Ghosh (1991) and Jinn *et al.* (1999) in *H. brasiliensis.*

In the experiment on the effect of polyhouses, the monthly mean air temperature inside and outside the polyhouse during the winter months was recorded (Fig. 2). Significant differences were observed between the maximum temperatures inside and outside the polyhouse, though the minimum temperatures were almost the same in both cases. However, the low temperature inside the polyhouses prevailed only for short time. The inside temperature increased higher than the ambient temperature outside the polyhouse during day time, and due to the tight polythene enclosure, heat could not dissipate easily even after sunset. Thus, polyhouses helped in conserving higher temperature for longer time. In the case of relative humidity, the ambient relative humidity outside was 57.9 per cent in winter months where as it was 77.8 per cent in pre-winter period when the bud-grafting is normally carried out in natural rubber. Moisture in the area surrounding the enclosure evaporated during the day time, but under the micro-environment inside the polyhouse high humidity could be maintained for a longer time. The results also showed that with regular water spray on the bud patches, bud sprouting improved significantly in plants kept inside the polyhouse (Table 1). An earlier study has shown that without the water spray on the bud patches, sprouting failed completely (unpublished data).

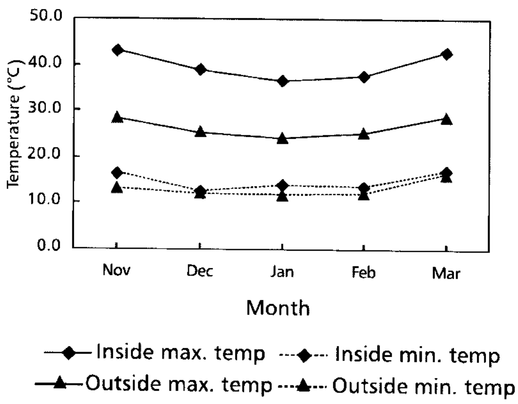

Fig. 2. Maximum and minimum temperature (monthly mean) inside and outside the polyhouse during winter months

Table 1. **Sprouting inside and outside the polyhouses with water spraying during winter months**

Month	Percentage of sprouting*		
	Open	Polyhouse	CD (P = 0.05)
November	45.0 (50)	60.0 (75)	4.50
December	39.2 (40)	62.0 (78)	4.90
January	26.5 (20)	68.0 (86)	3.03
February	30.0 (25)	63.4 (80)	3.24
March	33.2 (30)	67.2 (85)	2.35

*Angular transformed values of percentage of sprouting. Actual percentage of sprouting in parentheses

In the open field, maximum sprouting percentage (50%) was observed during November when the mean maximum and minimum atmospheric temperatures were around 29 °C and 13 °C, respectively. Sprouting inside the polyhouses during that month was significantly high (75%) where the temperature range was 43.3 °C and 16.3 °C, respectively. This observation confirms the results from an earlier work at RRS, Tura (RRII, 1994). Maximum sprouting inside the polyhouse was around 86 per cent during the month of January, compared to only 20 per cent in the open field, though the regular irrigation schedules and water spray on the bud patches were same in both conditions. Generally, the atmospheric temperature during January is the lowest, without much difference between the minimum and maximum values (11.8 °C and 14.1 °C, respectively), and with very low humidity that does not favour sprouting. The minimum and maximum temperatures during January inside the polyhouse were 16.3 °C and 36.7 °C, respectively which indicated that it was possible to maintain higher temperature inside the polyhouse due to greenhouse effect, which provided better conditions to the plants for growth and development. The difference between daily temperatures with high humidity inside the polyhouse helped in breaking the dormancy of the buds. Asante and Barnett (1998) explained the stress effect of low temperature on graft union formation in mango. Soaking the bud patches with water spray also helped buds to sprout, as the cotton on the bud patches remained wet for longer period and the humidity was high inside the polyhouse. However, in the open conditions, the cotton as well as the bud patch dried easily due to low humidity in the ambient atmosphere. This suggests that higher maximum temperature with higher moisture conditions are the factors necessary for healthy bud sprouting during winter. This observation is supported by the reports of Biddulph *et al.* (2005; 2007) on wheat, Kumar *et al.* (2003) on tamarind, and Pampanna and Sulikeri (2000) in sapota. In *Curcuma longa* L. it was observed that temperatures between 25-35 °C enhanced the rate of sprouting for the rhizome buds (Ishimine *et al.*, 2004). Similar trend was noticed in sugarcane by Miah *et al.* (1988).

Table 2. **Growth of budded plants grown inside and outside the polyhouse seven months after planting**

Parameter*	Polyhouse	Open field	CD (P = 0.05)
Mean girth (cm)	02.04	01.06	1.27
Mean height (cm)	47.80	19.80	7.60
Mean no. whorls	02.60	01.40	0.65

* Recorded during June, 2008

To evaluate the performance of the bud-grafted plants grown inside and outside the polyhouses, girth, height and number of leaf storeys were recorded till the end of June. It was evident (Table 2) that plants grown inside the polyhouses were healthier than those grown in open field. This also indicated that the cold temperature not only affected bud sprouting but also retarded the general growth parameters.

This study proved that it was possible to generate more healthy planting materials for early planting in Tripura by utilising the winter period for budding followed by growing the polybag plants inside a polyhouse to mitigate the cold effect. Though low temperature in winter months inhibits bud sprouting, it is possible to break the bud dormancy by imposing high temperature (37-43 °C) associated with high moisture condition with the use of a polyhouse.

REFERENCES

Asante, A.K. and Barnett, J.R. (1998). Effect of temperature on graft union formation in mango (*Mangifera indica* L.). *Tropical Agriculture*, **75**: 401-404.

Biddulph, T.B., Mares, D.J., Plummer, J.A. and Setter, T.L. (2005). Drought and high temperature increases pre-harvest sprouting tolerance in a genotype without grain dormancy. *Euphytica*, **143**: 277-283.

Biddulph, T.B., Plummer, J.A., Setter, T.L. and Mares, D.J. (2007). Influence of high temperature and terminal moisture stress on dormancy in wheat (*Triticum aestivum* L.). *Field Crops Research*, **103**(2):139-153.

Ghosh, H.N. (1991). Variation of budding success in *Hevea brasiliensis* under the agroclimatic conditions of Tripura. *Annals of Agriculture Research*, **12**(1): 68-71.

Ishimine, Y., Hossain, M.A., Motomura, K., Akamine, H. and Hirayama, T. (2004). Effects of planting date on emergence, growth and yield of turmeric (*Curcuma longa* L.) in Okinawa Prefecture, Southern Japan. *Japanese Journal of Tropical Agriculture*, **48**(1): 10-16.

Jinn, W., Haiyan, T., Wei-min, T. and Bingzhong, H. (1999). Brazilian rubber tree season of growth and differentiation. *Chinese Journal of Tropical Crops*, **3**: 60-62.

Kumar, S., Mokashi A.N. and Hegde, R.V. (2003). Influence of season on success of wedge grafting under propagation structure (Mist chamber) in tamarind (*Tamarindus indica* L.). *Madras Agriculture Journal*, **90** (4-6): 384-386.

Miah, M.A., Matin, M.A. and Hossain, M.A. (1988). Germination responses of two sugarcane varieties in ambient temperature. *Bangladesh Journal of Sugarcane*, **10**: 17-22.

Pampanna, Y. and Sulikeri, G.S. (2000). Effect of season on the success and growth of soft wood grafts in sapota on invigorated rayan root stock. *Karnataka Journal of Agricultural Sciences*, **13**: 779-782.

RRII (1994). Annual Report 1993-94, Rubber Research Institute of India, Kottayam, India. 52 p.