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FIELD PERFORMANCE OF POLYBAG AND ROOT TRAINER RUBBER PLANTS AT DIFFERENT STAGES OF GROWTH

Sherin George, Sabu P. Idicula, T.A. Soman and V.K. Syamala

Rubber Research Institute of India, Rubber Board, Kottayam-686 009, Kerala, India

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An experiment investigating the comparative field performance of polybag and root trainer rubber plants was initiated at the Central Experiment Station, Chethackal of the Rubber Research Institute of India representing the traditional rubber growing region in India during 2008 with clone RRII 105. The treatments comprised of combinations of two types of planting material *viz.*, direct-seeded green- budded polybag plants and root trainer plants (raised by planting budded stumps) at three growth stages *viz.*, one- whorl, two -whorl and three-whorl. Observations on growth were recorded for a period of four years. Success in establishment was hundred per cent in the field irrespective of the planting material and its growth stages. The variability in girth quantified using CV for polybag one-whorl, two-whorl, three-whorl and root trainer one-whorl, two-whorl and three-whorl plants was 12.7, 12.8, 12.4, 12.4, 12.7 and 11.1 per cent respectively. The significant difference observed in the girth of the plants among the types of planting material and its stages during the initial years progressively became less apparent and by two and a half years, only three- whorled polybag plants were significantly superior to others. The same trend continued in the four years also. The performance of all other planting materials *viz.*, polybag - one- whorl, two-whorl and root trainer - one-whorl, two-whorl and three-whorl was comparable. However, among these, considering the practical convenience and cost involved, root trainer one- whorl plants appeared to be the ideal planting material for commercial planting of *Hevea*. The constraints and advantages of different planting materials are also discussed.

Keywords: Growth, Immature rubber, Number of whorls, Polybag, Root trainer

INTRODUCTION

Hevea brasiliensis, the principal source of natural rubber, is a tropical perennial tree crop with a prolonged gestation period ranging from five to ten years and the need for reducing the gestation period attained importance from the day of commencement of commercial planting. The duration of immaturity in *H. brasiliensis* depends on the inherent clonal characteristics, type and quality of planting materials used, edaphic and environmental factors, agro-management practices adopted and biotic and abiotic stresses (George *et al.*, 2009). Of these, the planting material, its type and quality, is of special significance as the extent of reversibility is limited considering the long gestation phase and the life span of 25-30 years. Since early 1960s, priorities of research have been directed to shorten the period of immaturity through

Correspondence: Sherin George (Email: sherin@rubberboard.org.in)

refinements of various propagation techniques to produce advanced planting materials *viz.*, polybag plants, stumped buddings, soil core plants and then the root trainer plants (Hurov, 1960; Leong *et al.*, 1986; Cheriyan, 1987; Marattukulam and Saraswathiyamma, 1992; Soman *et al.*, 2002). Polybag plants of adequate growth are recognized as ideal planting material to ensure uniform stand and reduce the casualties in the field (Punnoose and Lakshmanan, 2000). A survey on use of planting materials in the traditional rubber growing regions indicated that two-whorl polybag plants are the most common planting material though planting of three-whorl plants resulted in a reduced gestation period compared to two-whorl plants (Joseph *et al.*, 2001). However, some small growers are of the opinion that one-whorl plants are performing better under field condition. An extensive field survey conducted recently on rubber nurseries in Kerala and Tamil Nadu revealed that there existed region-specific demand for different types of planting material despite the current recommendation (Joseph *et al.*, 2009). The Rubber Research Institute of India has come out with a novel method of raising plants in root trainers (Soman *et al.*, 2002) which is set to bring about a sea-change in rubber planting operations and help the rubber planters through hardness of labour shortage ahead (Mydin *et al.*, 2010). The better root development facilitated by the root trainer leads to an improved field establishment and growth resulting in early and high percentage tappability and it is highly cost-effective (Soman *et al.*, 2011). In this context, an experiment investigating the comparative field performance of polybag and root trainer rubber plants at different growth stages was initiated.

MATERIALS AND METHODS

A field experiment was laid out at the Central Experiment Station, Chethackal of the Rubber Research Institute of India representing the traditional rubber growing region in India during 2008 with clone RRII 105 to evaluate the effect of type of planting material and its growth stages on growth of immature rubber. The treatments comprised of combinations of two types of planting material *viz.*, direct-seeded green-budded polybag plants and root trainer plants (raised by planting budded stumps) at three growth stages *viz.*, one-whorl, two-whorl and three-whorl. Accordingly there were six treatments laid out in RBD with five replications. The gross plot size was 15 plants. For raising polybag plants, black polythene bags of size 45 x 18 cm were filled with top soil. Germinated seeds were planted in polybags and green budded *in situ* on the same day in all types of polybag plants. One-whorl, two-whorl and three-whorled plants were raised by adjusting the time of cut back so that the stock plants are of the same age. After successful bud grafting, brown-budded stumps were planted in root trainer cups of 30 cm length and 7.5 cm diameter with 800 cc capacity and root trainer one-whorl, two-whorl and three-whorl plants were selected from the same nursery so that the age of the stock plants being the same irrespective of the stages. The soil of the experimental site was sandy clay loam in texture. The area was under regular fertilizer application and all cultural operations were done as per the recommendations of RRII (Punnoose and Lakshmanan, 2000). *Pueraria phaseoloides* was established and maintained as the cover crop in the inter-space during the immature phase. Growth parameters, *viz.*, diameter, height and number of whorls, were

recorded at six-months and one year. From 2nd year onwards the girth of the tree was recorded periodically at a height of 150 cm above the bud union. The variability in girth was assessed by computing the CV of girth during the fourth year of planting. The data were subjected to analysis of variance.

RESULTS AND DISCUSSION

Establishment and growth of plants

The establishment success after planting was hundred per cent irrespective of the treatments. The success is always dependent on the type of planting material and the prevailing weather conditions (Haridas *et al.*, 1986). In this experiment, the planting was undertaken during June with the onset of South-West monsoon using planting materials with an active root system which later resulted in better establishment and survival of plants in field.

No root coiling was observed at the time of planting of different types of planting materials. A slight lateral bending was observed in the case of a few polybag plants. In such cases, the tap root was cut at the point of bending without disturbing the soil core while planting. In the polybags, the plants were kept only for 9-10 months. This may be the reason for the lack of coiling of tap root and laterals in polybags which was often observed especially when the plants were retained in the bags for a long period.

Table 1. **Effect of types of planting material and their stage on growth parameters after six months (November, 2008)**

Treatment	Diameter (mm)	No. of whorls	Height (cm)
Polybag plants (one-whorl)	9.09	3.34	64.17
Polybag plants (two-whorl)	10.45	3.76	84.81
Polybag plants (three-whorl)	11.31	4.61	102.20
Root trainer plants (one-whorl)	5.32	2.72	35.47
Root trainer plants (two-whorl)	7.57	3.28	55.31
Root trainer plants (three-whorl)	10.37	4.34	80.27
SE	0.24	0.2	3.65
CD(P=0.05)	0.72	0.59	10.79

Table 2. **Effect of types of planting material and their stage on growth parameters after one year (June, 2009)**

Treatment	Diameter (mm)	No. of whorls	Height (cm)
Polybag plants (one-whorl)	24.28	5.78	258
Polybag plants (two-whorl)	26.00	6.03	271
Polybag plants (three-whorl)	29.85	6.40	325
Root trainer plants (one-whorl)	21.25	5.32	217
Root trainer plants (two-whorl)	22.40	5.64	237
Root trainer plants (three-whorl)	27.31	6.42	285
SE	0.82	0.14	12
CD(P=0.05)	2.42	0.43	37

The growth parameters *viz.*, diameter, plant height and number of whorls recorded at six months (November, 2008) and one year after planting (June, 2009) (Table 1&2) showed significant differences among different stages of the same type of planting material (polybag - one-whorl, two-whorl and three-whorl and root trainer - one-whorl, two-whorl and three-whorl) and between the same stage of both types of planting material (polybag and root trainer one-whorl, polybag and root trainer two-whorls and polybag and root trainer three-whorls). One year after planting, three-whorl, polybag plants recorded the highest diameter which was significantly superior to others followed by three-whorl root trainer and two-whorl polybag plants both being comparable. The same trend was noticed for the height of the plants also. However, in June, 2009, after one year of growth, the height of one-whorl and two-whorl polybag plants and one-whorl and two-whorl root trainer plants was on par. The number of whorls was found to be significantly higher for polybag and root trainer three-whorl plants compared to respective one-whorl and two-whorl plants except in June, 2009 where polybag two-whorl and three-whorl plants were comparable. For same stage of the both types of planting material, no significant difference was observed in number of whorls.

The data on growth of the plants at one and a half (January, 2010) and two years (June, 2010) after planting (Table 3) also indicated significant difference in the girth of the plants among different stages of the same type of planting material (polybag - one-whorl, two-whorl and three-whorl and root trainer - one-whorl, two-whorl and three- whorl). Three whorl plants were significantly superior to two-whorls which in turn were superior to one-whorl plants irrespective of the type of planting material. There was no significant difference between the same stages of both types of planting material. However, the superiority of the three-whorl polybag plants continued followed by root trainer three-whorl and polybag two-whorl plants which were comparable by the end of second year.

The significant difference in girth observed among different stages of the planting materials progressively became less apparent and by two and a half years (February, 2011) the growth of one-whorl and two-whorl polybag plants and one-whorl, two-whorl and three-whorl root trainer plants was on par (Table 3). However,

Table 3. **Effect of types of planting material and their stage on growth of rubber**

Treatment	Girth (cm)				
	1/10 (1 $^1/_2$ years)	6/10 (2 years)	2/11 (2 $^1/_2$ years)	11/11 (3 $^1/_2$ years)	7/12 (4 years)
Polybag plants (one-whorl)	9.72	11.63	18.70	27.03	29.23
Polybag plants (two-whorl)	11.04	13.08	19.06	27.68	29.13
Polybag plants (three-whorl)	12.56	16.03	22.04	31.94	34.43
Root trainer plants (one-whorl)	9.27	11.63	18.73	27.72	29.94
Root trainer plants (two-whorl)	10.61	12.90	19.01	28.17	29.81
Root trainer plants (three-whorl)	11.55	14.14	19.75	28.26	30.67
SE	0.31	0.36	0.4	0.68	0.72
CD(P=0.05)	0.92	1.09	1.19	2.04	2.13

the vigour of three-whorl-polybag plants was consistently maintained and the growth was significantly superior to all others irrespective of the type of planting material and its other stages till four years after planting (July, 2012).

Uniformity

The variability in the girth of different planting materials was quantified by computing coefficient of variation (CV) and is depicted in Figure 1. The CV of girth of one-whorl, two-whorl, three-whorl polybag plants and one-whorl, two-whorl and three- whorl root trainer plants were 12.72, 12.82, 12.38, 12.35, 12.67 and 11.05 per cent respectively. It may be noted that there is not much variability in girth among the different planting materials and the highest uniformity was noticed for the root trainer three-whorl plants whereas the variability was the highest for polybag two-whorl plants. In general, better uniformity was noticed in the case of root trainer plants.

The growth advantage of advanced planting materials in attaining maturity earlier in the field is well documented (Haridas *et al.*, 1986; Cherian, 1987; Ahmed *et al.*, 2006). A comparative study on the performance of different types of planting material showed that polybag plants of advanced growth (12-month-old) are more suitable for field planting than six-month-old polybag plants and budded stumps because of uniform growth, better establishment, higher survival and growth rate (Nair *et al.*, 1992). The reason for better performance can be attributed to their well-developed root system at the time of planting which enabled more efficient uptake of moisture and nutrients.

An extensive survey on the duration of immature phase of polybag plants and budded stump plants indicated that a vital

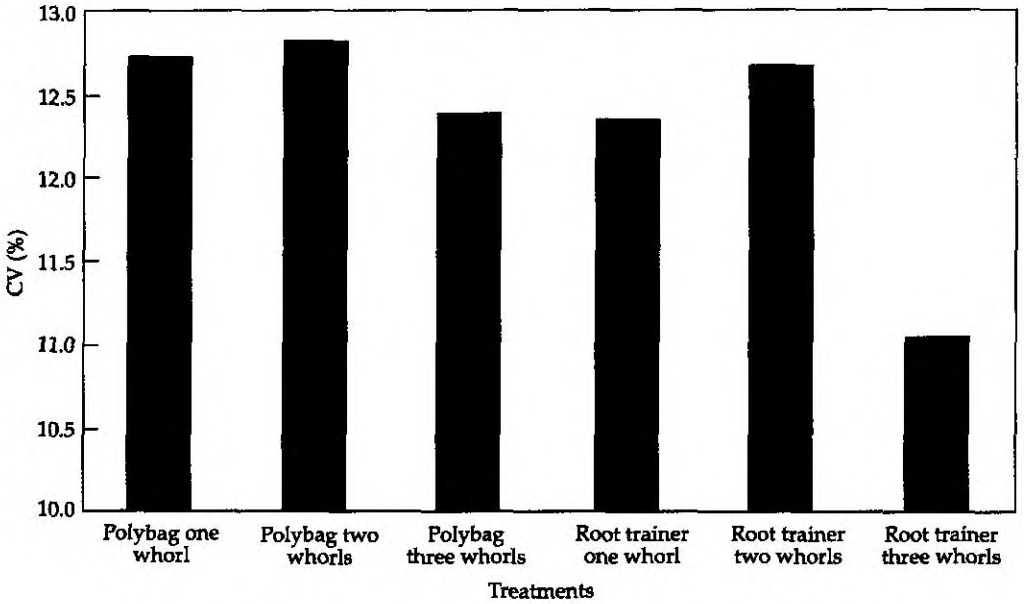

Fig.1. Effect of type of planting material and growth stage on variability in girth

aspect with regard to polybag plants is the number of whorls at the time of field planting and there is a significant inverse relationship between the number of whorls and duration of immature phase. The study also revealed that the extent of gestation period of two-whorl plants was significantly higher compared to those with three or more whorls and the mean difference between three and four or more whorls is insignificant and hence suggested that polybag plants should have at least three whorls to shorten the immaturity period (Joseph *et al.*, 2001).

In the present study, it was observed that the initial vigour of the three-whorl polybag plants was consistently maintained and the growth of these plants was significantly superior to all others whereas the difference observed between one-whorl and two-whorl polybag plants and one-whorl, two-whorl and three-whorl root trainer plants during the initial years had diminished and the performance of all these planting materials became comparable. However, in the other field experiments comparing the growth of root trainer and polybag plants raised by planting budded stumps, superiority of root trainer plants was indicated in terms of growth and percentage tappability (Soman *et al.*, 2011; Gireesh *et al.*, 2012). It may be noted that polybag plants used in this experiment were direct-seeded plants with an undisturbed root system and the budding was done *in situ* and root trainer plants were produced by planting budded stumps in poly bags. The *in situ* preparation of polybag plants does not place any restriction on the development of root system and a well-developed root system was always associated with the direct - seeded plants (Mani *et al.*, 1990; Syamala *et al.*, 2010; George *et al.*, 2011). Even though brown-budded stumps were planted in root trainer cups, the root trainer technique itself helped to induce prolific root growth resulting in a comparable growth to that of direct- seeded green-budded plants. The added advantages with root trainer technique are that it avoids deformity and coiling of tap root and laterals, it is cost-effective and transporting and planting are made extremely simple and cost of planting is only one third of that of polybag plants (Soman *et al.*, 2011).

The results of the present experiment indicated the superiority of polybag three-whorl plants in the growth of young rubber. Nevertheless, the limitations are the higher cost required towards preparation, transportation and planting. The performance of all other planting materials *viz.*, polybag - one whorl, two whorls and root trainer - one whorl, two whorls and three whorls was comparable. However, among these, considering the practical convenience and cost involved, one-whorl root trainer plants appear to be the ideal planting material for commercial planting of *H. brasiliensis*.

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