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ROOTING CHARACTERISTICS OF POLYBAGGED PLANTS OF *HEVEA BRASILIENSIS*

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The effect of size and type of polybags and that of nursery practices on rooting characteristics of polybagged plants of *Hevea brasiliensis* was studied. Direct seeding in polybags significantly increased the length, girth and dry weight of tap roots. The lateral and feeder roots were more for plants raised by direct seeding. In general, larger polybags had a positive effect on root growth. Retaining the plants in the polybags beyond 10 months after sowing resulted in curling of tap root. It was concluded that polybagged plants raised by direct seeding had better root growth, which helped in their better survival on field planting.

Key words: *Hevea brasiliensis*, Planting material, Polybag plant, Rooting character.

INTRODUCTION

Advanced planting materials in the form of polybagged plants have become a widely accepted plating material in the cultivation of *Hevea brasiliensis*. These materials have helped in reducing the immaturity period of rubber tree (Abraham, 1986). It has been reported that 83.5 per cent of fields of small growers in India was planted with polybagged plants during 1987 (Krishnakumar and Nair, 1999). Budded plants with well developed root systems are more efficient in absorbing water and nutrients (Samarappuli *et al.*, 1996). The effect of the type of planting material on the rooting habits of the polybagged plant could be a vital component in the initial vigour and establishment of the plants. Not much information is available on the effect of root trimming on the subsequent growth of the tap root. The development and distribution of fine rootlets (feeder roots) have great influence on the growth and nutrition of the rubber tree (Soong, 1976).

The growth of tap root being most important in anchorage of the plant, proper documentation of the rooting is essential. Therefore, information regarding the pattern of rooting in planting materials raised under different conditions is presented in this paper with the objective of documenting rooting habits of planting materials grown in polybags of different sizes with and without bottom and to study the effect of root trimming on the subsequent growth of the tap root.

MATERIALS AND METHODS

The study was undertaken at Central Experiment Station of Rubber Research Institute of India, Chethackal, with 12 treatments replicated four times in a completely randomised design. The treatments were as follows:

T_1 A : Seedlings raised in 55 x 25 cm polybags and allowed to grow in the same bag after budding.

T_1 B : Seedlings raised in 55 x 25 cm

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polybags without base and allowed to grow in the same bag after budding.

T_2 A : Seedlings raised in seedling nursery, pulled out after green budding and planted in 55 x 25 cm polybags without trimming the tap root.

T_2 B : Seedlings raised in seedling nursery, pulled out after green budding and planted in 55 x 25 cm polybags without base and without trimming the tap root.

T_3 A : Seedlings raised in seedling nursery, pulled out after green budding and planted in 55 x 25 cm polybags after cutting back the tap root at 30 cm length.

T_3 B : Seedlings raised in seedling nursery, pulled out after green budding and planted in 55 x 25 cm polybags without base and after cutting back the tap root at 30 cm length.

T_4 A : Seedlings raised in 65 x 35 cm polybags and allowed to grow in the same bag after budding.

T_4 B : Seedlings raised in 65 x 35 cm polybags without base and allowed to grow in the same bag after budding.

T_5 A : Seedlings raised in seedling nursery, pulled out after green budding and planted in 65 x 35 cm polybags without trimming the tap root.

T_5 B : Seedlings raised in seedling nursery, pulled out after green budding and planted in 65 x 35 cm polybags without base and without trimming the tap root.

T_6 A : Seedlings raised in seedling nursery, pulled out after green budding and planted in 65 x 35 cm polybags after cutting back the tap root at 30 cm length.

T_6 B : Seedlings raised in seedling nursery, pulled out after green budding and planted in 65 x 35 cm polybags without base after cutting back the tap root at 30 cm length.

Sowing of seeds in both polybags and in the seedling nursery was undertaken simultaneously in August 1997. Green budding was done in November 1997 and budded stumps were planted in polybags by December 1997.

Each treatment had 40 plants. Destructive sampling was done at 6, 8, 10, 12 and 14 months after seeding (MAS). Observations on length, girth and dry weight of tap root, number of lateral roots and dry weight of lateral and feeder roots (fibrous roots arising from the lateral roots) were recorded. All the polybags were placed in trenches. Polybags without base were placed on 30 cm layer of river sand overlying another layer of 30 cm loose soil to enable unhindered root growth for the entire period of observation.

During destructive sampling, the plants in polybags were removed and the soil core was broken with minimum damage to the root system. The plants were washed gently under running tap water over a fine soil sieve and after removing the adhering soil particles, the observations were recorded.

RESULTS

Length of tap root

There were significant differences in length of tap root between the treatments. Plants in the larger polybags (65 x 35 cm) had comparatively longer tap roots (Table 1). Plants grown by seeding the polybags directly (T_1A, T_1B, T_4A and T_4B) had longer tap roots as compared to the others during the entire period of observation. Plants in polybags with their base intact had a tendency of the tap root curling at the bottom of the polybag (Fig. 1). In all the treatments it was indicated that the planting materials could be retained in

Table 1. **Length of tap root (cm) of polybagged plants of rubber at different ages as influenced by nursery practices**

Treatment	Age of plant				
	6 MAS	8 MAS	10MAS	12 MAS	14 MAS
T_1A	71.6	96.1	117.3	124.0	141.1
T_1B	120.0	107.5	122.4	124.9	112.1
T_2A	52.0	63.8	63.9	93.4	101.8
T_2B	42.6	45.0	67.4	98.3	103.4
T_3A	54.0	73.3	66.9	89.9	103.8
T_3B	50.0	60.3	64.0	96.5	117.8
T_4A	99.0	101.5	102.0	129.1	154.9
T_4B	120.0	109.9	120.0	142.1	139.0
T_5A	96.6	76.2	77.6	102.9	107.0
T_5B	57.5	74.3	59.3	75.9	108.3
T_6A	70.8	72.2	84.6	87.6	121.2
T_6B	44.3	62.1	74.0	114.0	116.6
SE	9.5	9.4	12.8	10.7	9.4
CD ($P \leq 0.05$)	19.3	19.2	26.0	21.6	19.1

MAS : Months after seeding

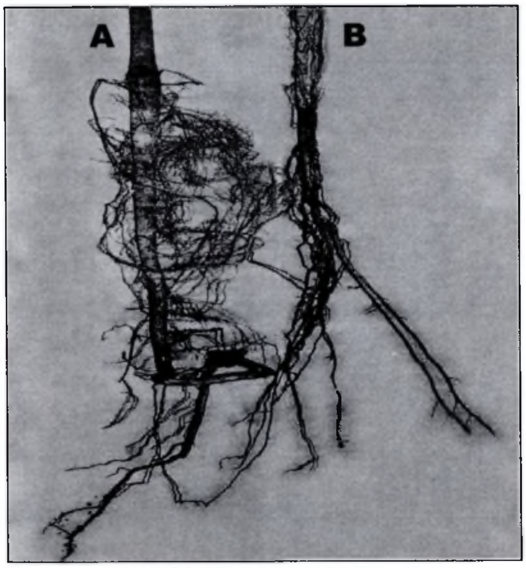

Fig. 1. Curling of tap root in polybagged plant
A : grown in polybag with bottom intact
B : grown in polybag without bottom

the polybags without root deformity only up to a maximum period of 10 months.

Growth of tap root

The trend in girth of tap root was similar to that observed in the case of length. At 6 MAS plants raised by direct seeding in polybag (T_1A, T_1B, T_4A and T_4B) had significantly higher root girth as compared to all other treatments (Table 2). Absolute values of these treatments were consistently higher throughout the period of observation. The higher root girth in the larger polybags towards the end of the observation period may be due to the availability of a larger volume of soil and moisture to the plants.

Dry weight of tap root

The dry weight of tap roots of plants with direct seeding in polybag ((T_1A, T_1B, T_4A and T_4B) was significantly higher than all other treatments till 12 MAS (Table 3). At 14 MAS, T_1A and T_4A maintained a significantly higher dry weight than all other treatments. Treatments T_1B and T_4B had dry weights higher in absolute terms as compared to all other treatments at 14 MAS. The higher dry weight of tap root observed in plants with direct seeding in polybags is a consequence of the higher tap root length and girth observed.

Table 2. Girth of tap root (cm) of polybagged plants of rubber at different stages as influenced by nursery practices

Treatment	Age of plant				
	6 MAS	8 MAS	10MAS	12 MAS	14 MAS
T_1A	6.4	7.9	5.8	5.5	7.8
T_1B	8.4	6.8	7.4	7.8	6.8
T_2A	4.4	4.8	2.9	4.1	2.3
T_2B	4.1	4.0	3.4	4.8	3.8
T_3A	4.8	4.5	2.8	4.9	3.8
T_3B	4.9	4.6	2.9	5.0	6.4
T_4A	7.1	5.9	3.9	9.0	8.0
T_4B	7.5	7.4	10.8	7.2	6.4
T_5A	3.8	4.3	3.0	4.1	4.4
T_5B	4.4	4.0	2.9	4.4	4.3
T_6A	4.3	5.2	3.3	6.1	4.3
T_6B	4.0	4.0	2.5	4.1	4.8
SE	0.4	0.6	1.0	0.9	0.9
CD ($P \leq 0.05$)	0.9	1.2	2.1	1.7	1.8

MAS : Months after seeding

Table 3. Dry weight of tap root of polybagged plants of rubber at different stages as influenced by nursery practices

Treatment	Age of plant				
	6 MAS	8 MAS	10MAS	12 MAS	14 MAS
T_1A	21.5	35.0	45.7	48.2	64.4
T_1B	49.7	32.0	66.0	64.7	51.6
T_2A	10.5	10.6	12.2	13.5	13.9
T_2B	9.3	6.6	15.1	14.2	17.3
T_3A	9.1	10.7	11.6	21.0	19.2
T_3B	8.4	10.2	10.3	14.6	38.6
T_4A	25.8	41.9	46.0	54.8	58.7
T_4B	33.9	41.4	93.6	42.4	52.8
T_5A	6.6	8.9	12.3	19.5	21.7
T_5B	8.6	8.7	14.3	13.2	38.9
T_6A	8.0	10.3	16.6	20.9	19.5
T_6B	6.7	11.0	12.1	17.2	28.6
SE	5.4	4.6	11.1	7.7	9.5
CD ($P \leq 0.05$)	10.9	9.2	22.5	15.2	19.2

MAS : Months after seeding

Number of lateral roots

Direct seeding of polybags tended to produce plants with more number of lateral roots as compared to those in other treatments (Table 4). At 6 MAS treatments T_1A, T_1B, T_4A and T_4B had significantly higher number of lateral roots compared to all other treatments. However, the differences among the treatments narrowed down by 12 MAS.

Dry weight of feeder and lateral roots

Dry weight of feeder and lateral roots at 6 MAS was significantly higher in plants grown by seeding the polybags directly (T_1A, T_1B, T_4A and T_4B) (Table 5). The highest dry weight of feeder and lateral roots was recorded in T_4A at 11

Table 4. **No. of lateral roots / plant of polybagged plants of rubber at different ages as influenced by nursery practices**

Treatment	Age of plant				
	6 MAS	8 MAS	10MAS	12 MAS	14 MAS
T_1A	20.0	33.8	18.0	23.0	36.6
T_1B	23.3	13.5	12.3	24.0	32.5
T_2A	8.4	12.3	29.1	20.9	15.4
T_2B	6.5	10.8	7.4	11.6	19.3
T_3A	10.1	14.4	10.0	23.6	19.3
T_3B	4.0	11.5	5.3	17.5	32.5
T_4A	25.5	25.3	23.0	34.4	34.3
T_4B	21.1	22.5	29.4	19.8	29.8
T_5A	4.8	16.1	9.0	21.5	24.9
T_5B	6.4	4.3	12.3	18.3	23.4
T_6A	6.5	6.0	15.9	20.1	24.9
T_6B	4.5	6.8	12.5	13.8	20.8
SE	2.2	3.6	4.2	3.8	4.0
CD ($P \leq 0.05$)	4.5	7.3	8.6	7.8	8.2

MAS : Months after seeding

Table 5. **Dry weight of feeder and lateral roots (g/plant) of polybagged plants of rubber at different ages as influenced by nursery practices**

Treatment	Age of plant				
	6 MAS	8 MAS	10MAS	12 MAS	14 MAS
T_1A	5.7	4.1	4.4	2.8	7.8
T_1B	3.6	2.2	2.7	1.5	6.3
T_2A	1.2	1.7	4.2	1.6	1.4
T_2B	0.7	0.7	2.0	1.0	1.5
T_3A	2.0	2.0	1.2	2.6	2.1
T_3B	0.6	1.7	0.7	1.1	2.8
T_4A	6.5	3.4	2.1	5.8	14.0
T_4B	5.2	4.9	6.4	3.0	6.0
T_5A	0.8	1.3	1.2	2.7	4.8
T_5B	0.5	0.7	1.2	1.5	8.1
T_6A	1.0	1.2	2.0	2.7	3.1
T_6B	0.4	0.4	1.4	0.7	2.4
SE	0.7	0.7	1.2	0.6	1.7
CD ($P \leq 0.05$)	1.4	1.5	2.4	1.3	3.5

MAS : Months after seeding

MAS. It was generally noted that there was abundant growth of feeder roots in all treatments of polybags with the bottom intact.

DISCUSSION

The results clearly indicate that direct sowing of the seeds in the polybags was a better method for raising polybagged plants since it helped in producing longer and thicker tap roots with more lateral roots irrespective of size of the polybag. The undisturbed condition of direct seeded plants resulted in their comparatively better root growth. The set back inflicted on the tap roots of transplanted plants was found to persist even at 14 MAS in terms of root growth.

The trimming of tap root at 30 cm before transplanting did not influence the tap root growth as compared to plants transplanted without trimming irrespective of the size of the polybag. It was observed that in treatments with and without tap root trimming, the regeneration of tap root was similar and new roots regenerated from the tap roots at the wounded site or above as observed earlier by Philippe and Loic (1997). In a number of instances, it was observed that more than one root assumed the role of tap root. Retention of plants in polybags beyond 10 MAS resulted in excessive curling of tap root. A curled tap root may affect the wind fastness of the plant. It was also noted that plants in polybags with base intact had a tendency to have extensive feeder roots, which formed mats (Fig. 2). This is because the soil remained moist in polybags with their base intact while in polybags with their bases removed there was relatively less moisture. There are reports that when there is enough of moisture, the feeder roots branch profusely (RRIM, 1958). An extensive root system would enable a polybagged plant to harvest moisture and nutrients from a larger volume of soil, which would be significant in the survival, and growth of the plant when it is field planted.

Fig. 2. Mats of feeder roots formed in closed polybags

CONCLUSION

A deep, strong and straight tap root enhances the anchorage of the plant. Use of larger polybags, although has certain advantages, may not be economically feasible especially considering the large volume of soil and consequent transportation problems in the field. Seeding in polybags was found to be the ideal method for ensuring better root growth and establishment of plants.

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