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Comparative Study of Raising Clonal Tea Plants in Polythene Bags and Soil Bed Using Single Nodal and Double Nodal Cuttings

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Abstract

Productivity of tea in south India is stagnating around 2328 kg/made tea/ ha/ year. The tea plantations in South India established approximately 100–120 years ago, have become unproductive due to issues such as bole canker and branch canker, compounded by infestations of shot hole borers. To improve tea productivity in South India, it is essential to replant the unproductive fields with high-yielding and superior-quality clones. Replanting the unproductive old seedling tea fields requires a substantial supply of nursery plants. To raise nursery plants in polythene bags, tea growers rely on black soil from nearby forest areas and river sand from authorized suppliers. Restriction for collecting black soil from the forest area and non-availability of river sand necessitated to search for an alternative method of vegetative propagation in soil bed instead of vegetative propagation in polythene bags. When nursery plants are raised in soil bed, after one year of growth, the rooted plants are uprooted and transplanted in the field and the soil and sand are retained in the nursery for future use. Whereas, nursery plants raised in polythene bags are transplanted in the field along with the soil. Hence, every year there is a need for collection of soil and sand for the tea nurseries. When the tea cuttings are propagated in the polythene bags, due to the restriction for the lateral growth of roots, most of the roots reached the bottom end of the polythene bags. Whereas, cuttings propagated in the soil bed, developed only lateral growth of roots and the nursery plants had only a shallow root system. Therefore, although there is an advantage of retaining the soil medium in the tea nurseries when the tea cuttings are propagated in the soil beds due to the development of shallow root system such a method is not advisable to be followed in south India. Between the two types of propagation material growth of the shoot system and root system of the nursery plants are superior in the double nodal cuttings, when compared to single nodal cuttings.

Keywords : Clonal tea plants, Vegetative propagation, Polythene bag, Seedlings, Soil bed

Tea is one of the most popular beverages, cultivated in North Indian states of Assam, West Bengal, Tripura, Meghalaya, Arunachal Pradesh and Himachal Pradesh, as well as in the South Indian states of Tamil Nadu, Kerala and Karnataka. All India production of tea is reported as 1368 million kg in the year 2023 from the total cultivated area of 6,19,770 ha (Anonymous, 2024). In South India, 75-80 per cent of the tea gardens were established 100-120 years ago, while the remaining 20–25 per cent have been replanted with improved tea cultivars developed by the Botany and Plant Improvement Division of the UPASI Tea Research Institute (Ilango, 2007). Productivity of the old seedlings tea populations has declined significantly due to the stem diseases like bole canker and branch canker followed by the infestation of the shot hole borer (Chandra Mouli & Sharma, 1993 and Muraleedharan & Selvasundaram,

1996). Due to prolonged drought and lightning many old seedling tea bushes have dried resulting in vacant patches in the tea fields. As a result, productivity of tea in south India is stagnating around 2328 kg/made tea/ha/year. The productivity of tea cannot be improved unless the unproductive tea fields are replanted with high-yielding and superior-quality clones. For replanting the old seedling tea as per the recommended planting style/spacing 13000 to 23000 clonal plants are required per hectare (Ilango *et al*., 2013).

In India, after the 1960s vegetatively propagated clones replaced seed propagation in order to achieve uniform yield and quality (Choubey *et al*., 2013). Most of the tea companies have their own tea nurseries for raising large number of clonal plants following the standard operating procedure of nursery practices. As per the current recommendation, clonal plants are vegetatively propagated in polythene bags through single nodal cuttings (one leaf and one node with one axillary bud). After raising, the clonal plants in the nursery for a period of one year, the plants are transplanted in the field along with the soil medium. While transplanting the one-year-old nursery plants propagated in the polythene bags, risk of root damage is reported while removing the young tea plants. Time is also wasted while carefully removing the plants along with the root system coiled with the soil medium out of the polythene bags (Katungwe, 2024). While transplanting the nursery plants in the field they are planted along with the soil medium. Therefore, every year there is a need for collection of soil and sand for the tea nurseries for vegetative propagation in the following years. Tea growers face challenges in sourcing soil or sand for tea nurseries due to government restrictions on collecting black soil from forest areas in the Western Ghats and lesser availability of river sand. Therefore, instead of raising clonal plants in the polythene bags, an attempt was made to raise clonal plants in the soil bed. After raising the clonal plants in the nursery for one year in soil beds, plants can be removed with the root system from the soil bed without soil medium and can be transplanted in the field.

It has been reported that number of branches per plant plays an important role in increasing the number of leaves thereby increase in the conversion of solar energy into the increased rate of photosynthesis which increases the dry matter per plant and yield (Choubey *et al*., 2013). When single nodal cuttings are used for vegetative propagation, after one year in the nursery, the plants are grown with few branches only. Therefore, instead of single nodal cuttings, bi-nodal cuttings are used for vegetative propagation to develop nursery plants with multiple branches. With is background a study was conducted to compare raising of tea plants in polythene bags and soil bed using single nodal cuttings and double nodal cuttings at UPASI Tea Research Institute, Valparai, Coimbatore, Tamil Nadu, during the year 2020-2021.

Material and Methods

Preparation of Soil Medium and Sand for Rising Plants in Polythene Bags

The standard operating procedure outlined by Sharma (1982) was followed in the technique of raising clonal plants in polythene bags for a period of one year. Black soil and red soil were collected from the forest, while river sand was procured from an authorized supplier. Black soil with a pH of 4.8 and river sand were mixed at a ratio of 2:1. Red soil with a pH of 4.8 and sand were mixed at a ratio of 1:1. As per the recommended practice, polythene bags with a thickness of 150-gauge and dimension of 30 cm × 10 cm were used for the study. The bottom 20 cm of the polythene bags was filled with black soil and sand mix and the top 10 cm were filled with red soil and sand mix. All the filled-up polythene bags were stacked in the nursery.

Preparation of Soil Medium and Sand for Rising Plants in Soil Bed

Soil beds measuring 1 meter in width, 15 meters in length and 30 cm in height were prepared within the same nursery. The bed was filled with black soil and sand mix up to 20 cm in height and the top 10 cm was filled with red soil and sand mix. Single nodal cuttings and double cuttings of three clones (TRF 4, UPASI 9 and TRI 2043) were planted in the soil bed (Plate 1 and Plate 2) at a spacing of 10 cm ×

Plate 1 : Raising single nodal cuttings in soil bed

Plate 2: Raising double nodal cuttings in soil bed

10 cm (10 cm -distance between the nodal cuttings, 10 cm-distance between the rows). The soil bed was covered with polythene tunnel (Gauge 400) and closed to maintain high humidity of around 80-85 per cent inside the polythene tunnel. Both the single nodal and double nodal cuttings raised in soil bed were grown in the nursery for a period of one year.

Types of Vegetative Propagation Material

Single nodal cuttings (Plate 3) and double nodal cuttings (Plate 4) were collected from mother bushes of the clone TRF 4, UPASI 9 and TRI 2043 and planted in the polythene bags filled with a sand and soil medium for rooting. The nursery bed was covered with polythene tunnel (Gauge 400) (Plate 5) and closed to maintain high humidity of around 80-85 per cent inside the polythene tunnel. Both the single nodal and double nodal cuttings raised in polythene bags and soil beds were grown in the nursery for a period of one year.

Observations

- Plant height: Plant height was measured from the collar region using by measuring scale
- Number of leaves: The total number of leaves per plant was counted
- Number of branches: The total number of leaves per plant was recorded

Plate 3 : Raising single nodal cuttings in polythene bags

Plate 4 : Raising double nodal cuttings in polythene bags

Plate 5: Polythene tunnel

- Root length: At first root was cleaned by dipping into the water to remove soil and then its length was measured using the measuring scale
- Fresh weight of roots: Fresh weight of root shoot was measured with a help of a digital weighing balance
- Dry weight of roots: Dry weight of root weight was measured after oven drying fresh root for 48 hours at 65°C

Statistical analysis: The experiment was conducted adopting Randomized Block Design (RBD) with 15 replications.

The data recorded on various parameters were subjected statistical analysis of variance (ANOVA) for data analysis data were tabulated in MS Excel and analysed by the critical difference (CD) at 5 per cent probability level was used as the test criterion and for comparison.

Results and Disscussion

At the end of the one-year nursery period, growth parameters such as plant height, number of leaves, number of branches and root length of the nursery plants were recorded. As reported by Katungwe, (2024) success of rooting in the nursery, growth of nursery plants, branching behaviour and root growth were influenced by the type of propagation material, soil medium used for raising tea cuttings and the type of pots/polythene bags used for vegetative propagation in the nursery. When the mean values of shoot growth and root growth parameters of all the three tea clones propagated through both single nodal cuttings and double nodal cuttings were statistically analysed all the growth parameters of the nursery plants raised in polythene bags were higher than the growth of nursery plants propagated in the soil beds (Table 1). Albert *et al*. (2023) reported that root serves as a crucial organ in plants, responsible for regulating shoot growth and overall plant development. Development of a better root system in the plants raised in polythene bags supported the growth of plant height, number of leaves and number of branches. When the tea cuttings are propagated in the polythene bags, due to the restriction for the lateral growth of roots, most of the roots were vertical in growth downwards and reached the bottom end of the polythene bags (Plate 6). Whereas, cuttings propagated in the soil bed, developed only lateral

Table 1

Vegetative growth of tea cuttings raised in polythene bags and soil bed (mean of three clones and two different propagation material)

Method of propagation	Plant height (cm)	Number of leaves	Number of branches	Root length (cm)	Fresh weight of roots (g)	Dry weight of roots (g)
Raising cuttings in polythene bags	46.3	27.7	2.5	29.2	40.6	10.3
Raising cuttings in soil bed	37.1	19.1	2.1	22.3	32.6	7.6
CD at 5%	1.12	0.64	0.13	0.84	1.43	1.01

Plate 6 : Single nodal cuttings raised in polythene bags (30 cm height)

Plate 7 : Single nodal cuttings raised in soil bed

growth of roots towards sideways and the nursery plants had only a shallow root system (Plate 7 and Plate 8).

Among the two different types of propagation material, double nodal cuttings promoted long roots with more fresh weight and dry weight of roots, when compared to the single nodal cuttings. Due to higher

Plate 8 : a. Double nodal cuttings in soil bed; b. Single nodal cuttings in soil bed

root volume in the nursery plants raised through double modal cuttings, vegetative growth in terms of plant height, number of leaves and number of branches are also more (Plate 7 and Plate 8) and (Table 2).

Tea clones are vegetatively propagated using either single nodal or double nodal cuttings in Malawi (Katungwe, 2024), whereas in Hawai single nodal cuttings are preferred for vegetative propagation (Hamasaki and Nakamoto, 2018). In the present study, raising single nodal cuttings in the polythene bags promoted higher growth rate of the root system than propagating the tea cuttings in soil bed. Increase in the fresh weight of roots in the single nodal cuttings raised in polythene bags is 1.24 fold higher than the cuttings raised in the soil bed. Similarly dry weight of the root system is also higher by 1.36 times than the cuttings raised in the polythene bags when compared to the tea cuttings raised in the soil bed (Table 3).

Due to the higher volume of root system in the single nodal cuttings raised in the polythene bags all the

TABLE 2

Vegetative growth of nursery plants raised through single cuttings and double nodal cuttings (mean of three clones and two different propagation methods)

Method of propagation	Plant height (cm)	Number of leaves	Number of branches	Root length (cm)	Fresh weight of roots (g)	Dry weight of roots (g)
Single nodal cuttings	31.7	17.6	1.2	21.2	30.6	7.1
Double nodal cuttings	51.7	29.2	3.4	30.2	42.6	11.1
CD at 5%	1.05	0.93	0.14	1.25	1.47	1.13

TABLE 3

Raising plants using single nodal cuttings in polythene bags and soil bed (mean of three clones)

Method of propagation	Plant height (cm)	Number of leaves	Number of branches	Root length (cm)	Fresh weight of roots (g)	Dry weight of roots (g)
Raising cuttings in polythene bags	36.3	20.2	1.4	23.8	33.8	7.9
Raising cuttings in soil bed	27.1	14.2	1.0	18.6	27.3	5.8
CD at 5%	1.38	0.94	0.14	0.77	1.72	1.82

TABLE 4

Raising plants using double nodal cuttings in polythene bags and soil bed (mean of three clones)

Method of propagation	Plant height (cm)	Number of leaves	Number of branches	Root length (cm)	Fresh weight of roots (g)	Dry weight of roots (g)
Raising cuttings in polythene bags	56.2	34.4	3.6	34.6	47.3	12.7
Raising cuttings in soil bed	47.2	24.1	3.1	25.9	37.8	9.4
CD at 5%	1.59	1.17	0.24	1.42	1.84	1.56

growth parameters of plant height, number of leaves and number of branches are also more. Among the three clones that were studied, growth of TRF 4 in terms of shoot growth and root growth is higher than the other two clones UPASI 9 and TRI 2043 (Figs. 1 and 10). Such a variation in the growth of the shoot system and root system in different cultivars in other crops is also reported (Chethankumar et al., 2024).

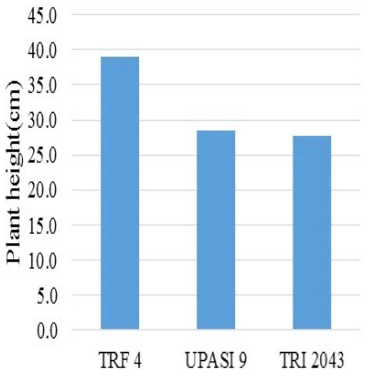

Fig. 1 : Plant height (cm)

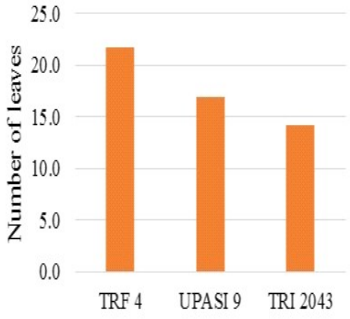

Fig. 2 : Number of leaves

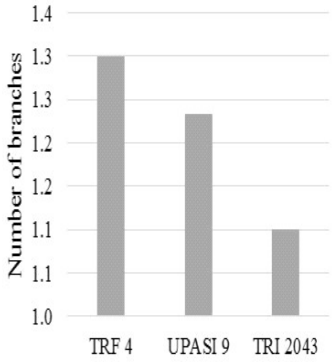

Fig. 3 : Number of branches

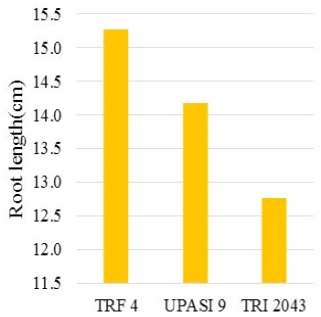

Fig. 4 : Root length (cm)

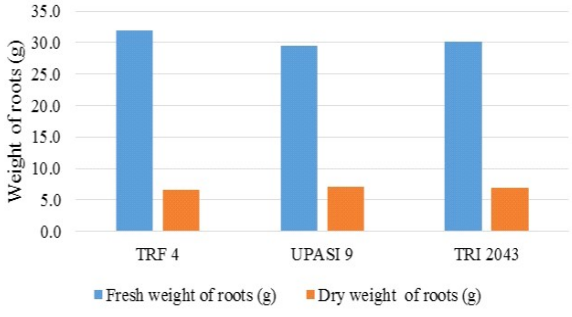

Fig. 5 : Fresh and dry weight of roots (g)

Fig. 1 to 5 : Raising plants using single nodal cuttings in polythene bags and soil bed for differnt clones

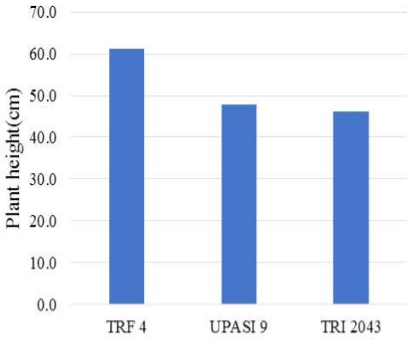

Fig. 6 : Plant height (cm)

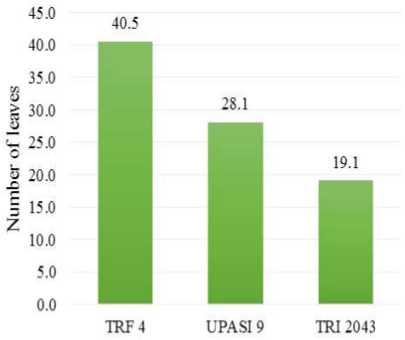

Fig. 7 : Number of leaves

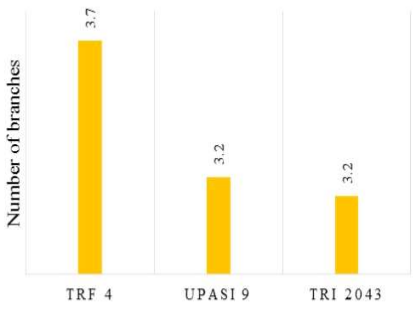

Fig. 8 : Number of branches

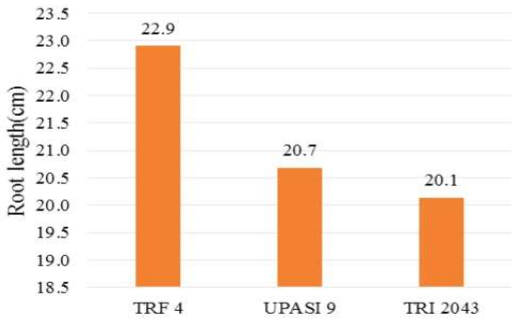

Fig. 9 : Root length (cm)

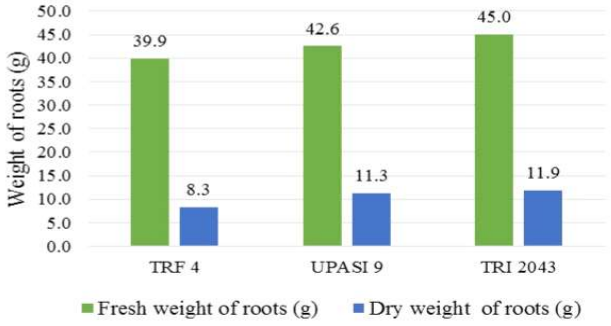

Fig. 10 : Fresh and dry weight of roots (g)

Fig. 1 to 5 : Raising plants using single nodal cuttings in polythene bags and soil bed for differnt clones

Variation in the growth of shoot system and root system in different clones may be due to genetic differences in endogenous auxin content (Samartin et al., 1986).

Double nodal cuttings raised in the polythene bags also promoted the growth of more roots, when compared to the cuttings raised in the soil bed. As a result, all the growth parameters of plant height, number of leaves and number of branches are also more in the nursery plants raised through polythene bags (Table 4).

Raising clonal plants in the soil beds without polythene bags failed to promote long root system that is required to achieve high success rate while transplanting the nursery plants in the field. Since tea in south India is grown as a rainfed crop, failure of summer rains in the months of February to May is reported to be one of the important reasons for the high casualty of young tea plants in the first two years after planting in the field (Ilango, 2007). Therefore, although there is an advantage of retaining the soil medium in the tea nurseries when the tea cuttings are propagated in the soil beds due to the development of lateral roots/shallow root system such a method is not advisable to be followed in south India. Sharma, (1982) reported that raising tea clones using single nodal cuttings is the most successful method in south India than multi- nodal cuttings due to the limitations of availability of mother plants and the ease in propagating the single nodal cuttings. Therefore, though the growth of the shoot system and root system of the nursery plants are superior in the double nodal cuttings as compared to single nodal cuttings, depending on the availability of the number of mother plants, tea growers can decide on the type of vegetative propagation material.

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