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Effect of size of bags and planting method of cuttings on the performance of nursery plants of tea (*Camellia sinensis* L.) clones

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ABSTRACT

Growth of tea plants raised in polybags of different sizes and on beds in the nursery was studied at Ratnapura, Sri Lanka over a period of one year. The results showed that sgrowth of tea plants increased with increasing diameter of polybags (23 cm long) from 7.5 cm to 15 cm. Shoot growth of bed plants was superior only to those raised in the smallest bag (7.5 cm), but the bed plants recorded poor root development. When considering the limitation of suitable soils for tea nurseries and the other growth related benefits, it can be concluded that the medium size bags (12.5 cm x 23 cm) recommended by the Tea Research Institute, Sri Lanka are more suitable for tea nurseries.

Key words: Dry weight, bag size, bed plants, growth, shoot length, leaf area, tea

INTRODUCTION

Vegetative propagation of tea is usually done by planting single nodal cuttings in nurseries. Although the most suitable way of raising nursery plants is in polybags (bagged plants), some tea growers, especially smallholders, plant cuttings in nursery beds (bed plants) for convenience and reducing cost. However, the performance of bed plants after planting in the field has been reported to be poorer than bagged plants. Experiments conducted in Kenya have shown that the casualties of bed plants can be as high as 50% or more when they are transplanted in the field. This has been attributed to the poor root system & damage to roots of bed plants while uprooting (Njugana 1982).

In Sri Lanka, nursery soils are usually obtained from rehabilitated areas planted with grasses. However, soils found in forest lands & old tea lands are also found to be suitable for tea nurseries. As a result of the absence of rehabilitated areas and use of abandoned or lands not suitable for cultivation for estate development and diversification programmes, many estates in Sri Lanka are faced with short supply of nursery soils. In order to raise 100,000 nursery plants, about 200 m^3 of soil are required. Therefore, securing a large quantity of soil for nurseries has often posed a problem for nurserymen with limited land availability. In Sri Lanka, 12.5 x 23 cm polythene bags have been recommended while in South India narrower bags (10 x 30 cm) are used (Kathiravetpillai and Kulasegaram 1986; Hudson *et al.* 1997). However, much lager bags are common in tea nurseries in North-East India, while smaller bags are recommended in Kenya (Bordoloi & Bezbaruah 1983; Njugana 1982; Sarkar 1973).

Although 23 cm x 12.5 cm nursery bags are recommended in Sri Lanka, different sizes of smaller bags are very common in tea nurseries at present. Hence, an experiment was conducted at the Tea Research Institute (TRI) Low Country Station, Ratnapura, Sri Lanka (60m amsl) to study the performance of different tea clones raised in different sizes of polybags (bagged plant) and in the bed (bed plants) during the nursery period of 12 months.

MATERIALS AND METHODS

Three clones of tea *viz.* TRI 2027, TRI 3041 and TRI 4049 were selected for testing the nursery performance with three different sizes (lay-flat) of polythene bags *viz.* 7.5x23, 12.5x23, 15x23 cm (hereafter described with the diameter only) and bed plants (approximately planted at 12.5 x 5 cm). The number of cuttings planted in each plot was 120. The treatments were replicated five times to analyze results in a factorial design. A loamy soil with a pH of 4.8 was excavated from a rehabilitated land & used as the growing medium for filling both nursery bags and beds. The top 5 cm of the bags and the bed were covered with a red sub soil. Single leaf cuttings each with a stem piece of 2.5 cm were planted in October, 1997 as described by Kathiravetpillai and Kulasegaram (1986).

All plants were covered with a coir matting (6mm mesh size) approximately 90 cm above ground. At rooting of cuttings, nursery fertilizer mixture T 65 (containing 10.9% N, 10.8% P_2O_5, 11.1% K_20 and 3.7% MgO) was applied at fortnightly intervals at the rate of 35 g in 5l of water for 120 plants. As the growth became vigorous, the amount of fertilizer dissolved was increased to 70g. Three applications of $ZnSo_4$ were also given at fortnightly intervals after rooting (14g in 5l of water per application for 120 plants).

Measurements

Five nursery plants from each plot were carefully uprooted at monthly intervals from 4 months after planting for the following measurements:

(1) Dry weight of roots and shoots (100 °C over night)
(2) Total length of shoots
(3) Total leaf area (Area Measurement System, Delta-T Devices Ltd, Cambridge, England)

RESULTS

Analysis of results showed no significant interaction between different clones and planting method. Hence the main effects are separately discussed. Although a number of measurements were carried out, weights of root and shoot, and shoot:root ratio were used to explain the results and avoid repetition of comparable effects. Performance of three clones in the nursery is shown in Figures 1 - 3. The shoot and root weight showed an exponential pattern of growth. The pattern of variation of shoot:root ratio was of parabolic type. A higher weight of root and shoot was recorded by TRI 4049 followed by TRI 2027. The TRI 3041 plants were smaller than the other two clones.

Effect of size of nursery bags on the growth of plant

The plant growth in polybags of different sizes was compared with that of bed plants in Figures 4-6. The patterns of variation of growth attributes were comparable to those explained under clonal variation. Except for root weight (Figure 4) and hence, shoot:root ratio (Figure 6), other growth attributes of bagged and bed plants varied with time consistently, *i.e.* faster rate of growth was recorded in the largest bag (15cm) and followed by 12.5cm bags and bed plants, respectively. The poorest growth was recorded by plants grown in the smallest bag (7.5cm). However, root weight of bed plants was found to be less than that of 7.5 cm bags (Figure 4). Moreover, bed plants recorded a significantly higher shoot:root ratio (Figure 6). Although there was a lower shoot:root ratio in 7.5cm and 15cm bags than in 12.5 cm bags at early age of growth, there was no

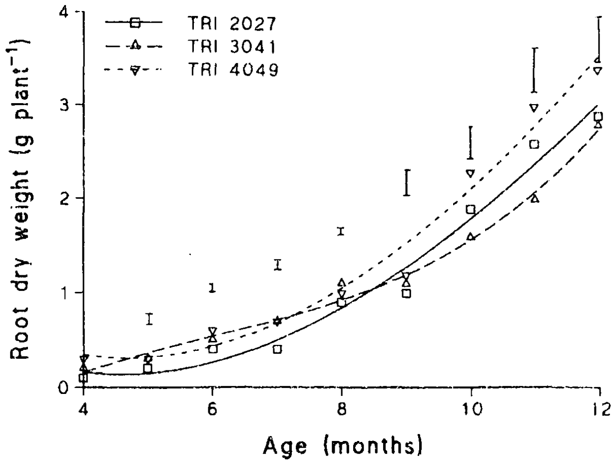

Fig 1. Effect of clone on root weight

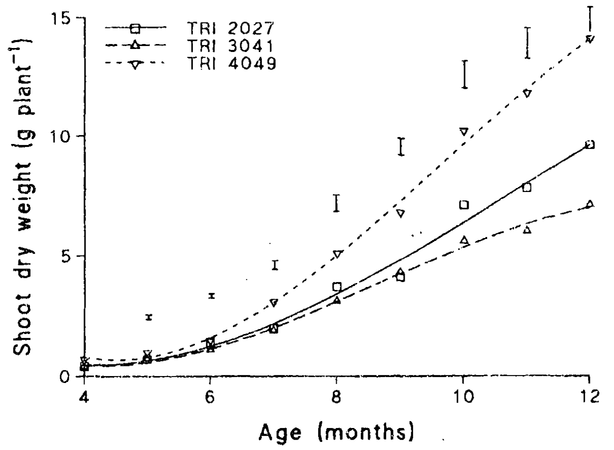

Fig. 2. Effect of clone on shoot weight

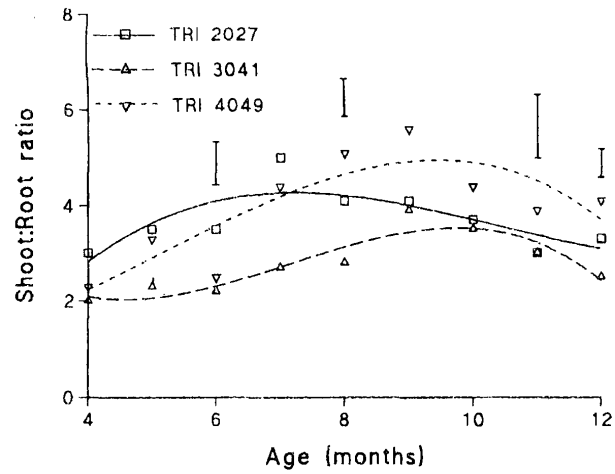

Fig. 3. Effect of clone shoot:root ratio

such difference at the end of the nursery period (Figure 6). Except in 7.5 cm bags, weight of shoots (Figure 5) and roots (Figure 4) increased exponentially without a significant decline in the rate of growth. All growth attributes of plants in 7.5 cm bags slowed down at the end of the nursery period(12 months).

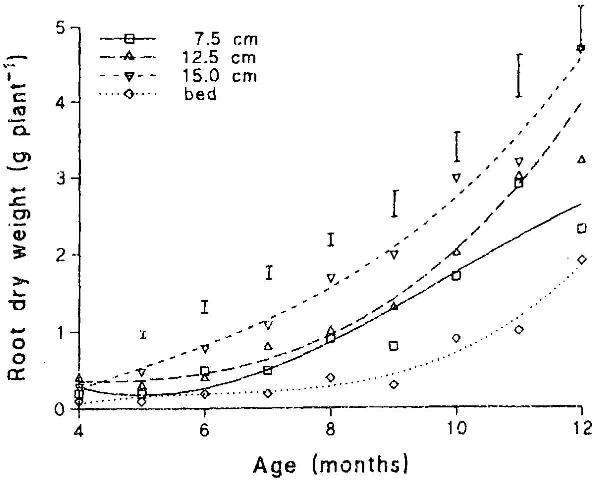

Fig. 4. Effect of bag size and planting method on root weight

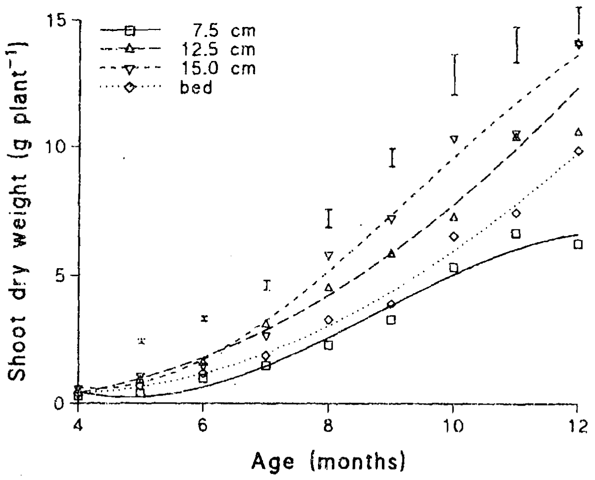

Fig. 5. Effect of bag size and planting method on shoot weight

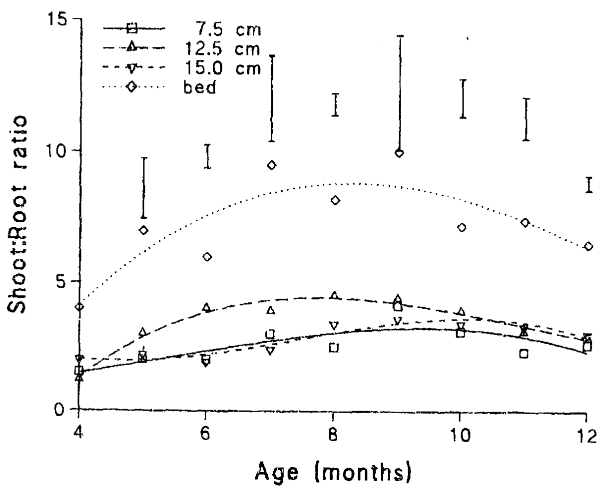

Fig. 6. Effect of bag size and planting method on shoot:root ratio

DISCUSSION

The nursery bags with a diameter of 7.5, 12.5 and 15 cm contained approximately 350, 1000 and 1425 cm^3 of soil, while bed plants had the chance of occupying a larger volume of soil than that of bags. The medium size (12.5cm) is the recommended size for tea nurseries in Sri Lanka. A faster rate of growth with profuse branching helps in reducing the nursery period and forming an early ground cover after field establishment. Moreover, a larger canopy with greater leaf area has the ability for producing more carbohydrates or dry matter. It also enhances growth of the plant and level of root starch reserves. The presence of a vigorous root system with a lower shoot:root ratio is a good indication of drought tolerance (Kaufmann 1981; Doley 1981).

The analysis of results on dry matter partitioning to roots and shoots suggests that the TRI 3041 clone has portioned more dry matter to roots than the other two clones. As a result, it has a lower shoot:root ratio (Figure 3) which can be identified as a favorable plant characteristic for drought tolerance (Kaufmann 1981; Doley 1981). The reduced shoot:root ratio at the end of the nursery period suggests that these plants have partitioned more dry matter to roots at the latter part of the nursery period, irrespective of the amount of soil and space available for growth. However, TRI 2027 appeared to be more actively partitioning dry matter to roots than the other two clones. The partitioning of dry matter to roots by this clone started earlier than the other two clones (Figure 3).

It was observed that the growth rate of plants in the smallest bag (7.5 cm) declined at the end of the nursery period. This can be the result of some limiting factors *viz.*, less volume of soil occupied by the root systems and inadequate space between plants for development of the canopy. Better nursery performance with 20 cm (diameter) bags than 15 cm bags reported by Tea Research Foundation of Central Africa are in agreement with these findings. They have also reported that bigger plants obtained from the larger bags suffered less casualties in the field during vagaries of weather (Scarborough and Kayange 1974). Very high shoot:root ratio (Figure 6) recorded by the bed plants could be the result of poor root development, compared to shoot growth (Figure 4). Such plants may record poor field establishment and suffer more casualties after transplanting in the field as reported by Njugana (1982). However, results of an experiment conducted at high elevation in Sri Lanka (1382 m amsl) have shown that the yield of young tea raised in different size of polybags (5-10 cm in diameter and 23-30 cm in length) recorded no significant difference in yield (Anandappa 1992).

It is evident from the results of this experiment that the benefits of increasing the size of nursery bags from 12.5 cm to 15 cm were comparatively less than that of increasing the bag size from 7.5cm to 12.5

cm. Moreover, soil requirement for filling larger bags (15 cm) is more than that for recommended bags (12.5 cm) *i.e.* about 140%. The results also showed that the smaller bags (7.5 cm) produced smaller and weak nursery plants which may require more time and care for field establishment and bringing them into bearing. When the growth of the canopy of nursery plants is considered, bed plants seemed to be superior to those of smaller bags (7.5 cm), but bed plants have other disadvantages such as poor root system and damage to root while uprooting.

CONCLUSION

Therefore, it can be concluded that the most suitable size of nursery bag is 12.5 cm x 23 cm (lay flat) which confirms the present recommendation of the TRI. However, larger size of bags may be used for infilling purposes where the growing conditions are different from new or replanting and, also when there is no short supply of nursery soils.

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