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Improved Seed Cultivars of Tea (*Camellia sinensis L.*): A Source of Planting Material

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ABSTRACT

Tea seed progenies, derived through open-pollination of known vegetatively propagated (VP) cultivars, were assessed against standard VP cultivars, in order to identify promising sources of improved seeds for use as planting material. Eleven seed progenies, from bi-and poly-clonal seed sources, were evaluated in a preliminary yield trial.

The average yield potential of all the seed cultivars tested were lower than that of a standard cultivar, TRI 2023. However, seed progeny from the seed garden at the Salawa Estate, Hanwella gave yields comparable to TRI 2023. Of the 11 seed cultivars tested, five showed yields comparable to that of the standard cultivars, TRI 4046 and DG 39. The results of the present study suggest that seed progenies from seed sources at the Salawa, Karadupona, Halpe, St Coombs and Reucastle Estates are more promising than other seed progenies, in terms of average yield and uniformity among individual stands based on yield attributes.

Key words: seed progenies, cultivars, seed garden.

INTRODUCTION

In Sri Lanka, tea (*Camellia sinensis* L.) is grown in different agro-climatic regions differing widely in elevation, climate and soil. These differences have a profound effect on productivity (Pethiyagoda, 1968). When varieties are compared in different environments, their relative rankings usually differ, and considerable genotypic differences in response to changes in environment were found (Wachira et al., 1990; Wickramaratne, 1981 a). This causes difficulties in demonstrating any significant superiority in a particular cultivar, thus affecting the efficiency of the selection process. Inconsistencies in performance, which makes interpretation of yield data difficult, were claimed to be due to the existence of a significant Genotype-Environment Interaction, GEI (Wickramaratne, 1981 a).

GEI is of major importance to the plant breeder in developing improved varieties. However, information on the type of interaction present in tea is scanty.

The use of genetically-mixed genotypes rather than homozygous, or pure-line varieties, has been suggested as a means for reducing the GEI (Jensen, 1952). Allard and Bradshaw (1964) showed that heterozygous and heterogeneous populations offer the best opportunity for producing cultivars which show a smaller GEI, because they exert a population-buffering effect.

Since the tea plant is highly heterozygous and virtually self-sterile, the progeny from tea seeds are not true-to-type, and show a wide range of variation in growth, vigour, morphological characters, yield potential, quality and resistance to pests and diseases. Hence, populations derived from natural hybridization between VP cultivars, with known traits, could exhibit population buffering and give wide regional adaptability. In addition, the desirability of maintaining genetic heterogeneity in tea plantations emphasizes the need for developing seeds as planting material.

The present study aims at evaluating the performance of some open-pollinated progenies, derived from bi-clonal and poly-clonal seed gardens, against the performance of promising VP cultivars, based on yield and yield components of seed populations.

MATERIALS AND METHODS

Tea seed bearers, established on various tea and rubber estates, were used to collect seed material for evaluation. Open-pollinated (naturally cross-pollinated) seeds were collected from 11 seed gardens (Table 1).

Bi-clonal and poly-clonal progenies were raised from mature seeds, collected directly from the tea seed bearers. Seeds were subjected to sinker–floater assessment, and the sinker seeds were sown on a germination bed made of river sand. After 3-4 weeks, germinated seeds were transferred to standard-size, nursery bags filled with soil.

Vigorous seedling plants were selected at the end of the nursery period, and planted in Field No. 2, St Joachim Estate, TRI, Ratnapura, in February 2000, to establish preliminary yield trials. The seedling progenies were planted in replicated plots, along with the popular commercial VP cultivars, TRI 2023, TRI 4046 and DG 39. Each plot consists of 40 plants, and the progenies were replicated thrice.

Table 1. Parental combinations of bi-clonal and poly-clonal seed sources.

Type of Seed Garden	Seed Source and year of establishment	Parental combination
Bi- Clonal	Densworth Estate, Dehiowita (1991)	TRI 2026 and TRI 3055
	El-teb Estate, Passara (1973)	TRI 2025 and DN
	Reucastle Estate, Dehiowita (1991)	TRI 3063 and S-106
Poly-Clonal	Aislaby Estate, Bandarawela (1956)	TRI 2023, 2024 and 2025
	Anhettigama Estate, Dereniyagala (1991)	TRI 2023, 2025, 2027, 2043 and 62/9
	Halpe Estate, Tummodara (1991)	TRI 2016, 2026, 2027, 2043, 3063, 4014 and S-106
	Karadupona Estate, Kegalle (1991)	TRI 2016, 2021, 2023, 2025, S 106 and DG 39
	Poonagala Group, Poonagala (1936)	Seed bearers raised from seedlings
	Salawa Estate, Hanwella (1991)	TRI 2016, 2023, 2027, 3047, 3055, KEN 16/3 and S 106
	Sapumalkanda, Estate, Dehiowita (1991)	TRI 2023, 2025, 2043, 3055, 4056, KEN 16/3 and S 106
	St. Coombs Estate, Talawakelle (1959)	TRI 777, 1114, 2024, 2025, 2026, 2043, 2142, 62/9, DT 1, DT 95 and ASM 4/10

The yield of green leaf was recorded weekly for a two-year period.

The following measurements were used to evaluate yield components of individual genotypes in each seed progeny, and to assess uniformity.

1. The shoot density (the number of shoots per unit area of bush). Measurements were taken using a 30 cm x 30 cm quad-rod, on the day prior to harvesting of shoots. Measurements were repeated three times during a period of one month.

2. The dry weight of harvested shoots. The oven-dry weight of the harvested shoots from each bush in each progeny was recorded. Measurements were repeated three times to obtain the average dry weights of harvested shoots per bush, from all the progenies.

Data were analyzed using the SAS software package, version 8.2. Dunnett's T test was used to compare the average yields of seed cultivars with that of the controls, namely the three standard VP cultivars. Parameters measured to assess uniformity were analyzed using univariate analysis.

RESULTS AND DISCUSSION

The average yield of the seed progenies was always less than that of the standard cultivars, TRI 2023 and 4046 (Table 2). However, there were instances where the average yield difference between the standard and the seed progeny was not significant.

Table 2. Average yield of seed progenies and standard VP cultivars.

Seed Progeny and ***standard VP cultivars***	Average Yield * (made tea kg/ha/year)	Mean comparisons with standard cultivars		
		TRI 2023	***TRI 4046***	***DG 39***
TRI 2023	3790	—		***
TRI 4046	3342		—	***
Salawa	2931			
Karadupona	2825	***		
Halpe	2788	***		
St. Coombs	2754	***		
Reucastle	2488	***		
DG 39	2437	***	***	—
Sapumalkanda	2430	***	***	
Densworth	2350	***	***	
Aislaby	2126	***	***	
Anhettigama	2125	***	***	
El-teb	1970	***	***	
Poonagala	1756	***	***	

* Yield was estimated on the basis of 12,500 bushes/ha and an out-turn of 23% made tea. The values represent means of three replicates over 43 plucking rounds per year.

*** Comparisons of mean yield significant at the 0.05 level by Dunnett's T test

Generally, it is an observed fact that a field planted with commercial seed gives a much lower average yield than a field planted with high-yielding clonal material (Wickramaratne, 1981 b). In comparison to the standard cultivar, TRI 2023, all the seed cultivars, except those from Salawa, showed significant differences in yields. On the other hand, in comparison to the standard cultivar, TRI 4046, yields were not significantly different in the seed progenies from Salawa, Karadupona, Halpe, St Coombs and Reucastle. These same seed progenies gave similar yields in comparison to the standard cultivar, DG 39.

Hence, according to all possible comparisons made with the three standard cultivars, it could be deduced that the five seed progenies are superior to the other seed cultivars tested, and comparable to the standard cultivars, TRI 4046 and DG 39, in terms of their average yields.

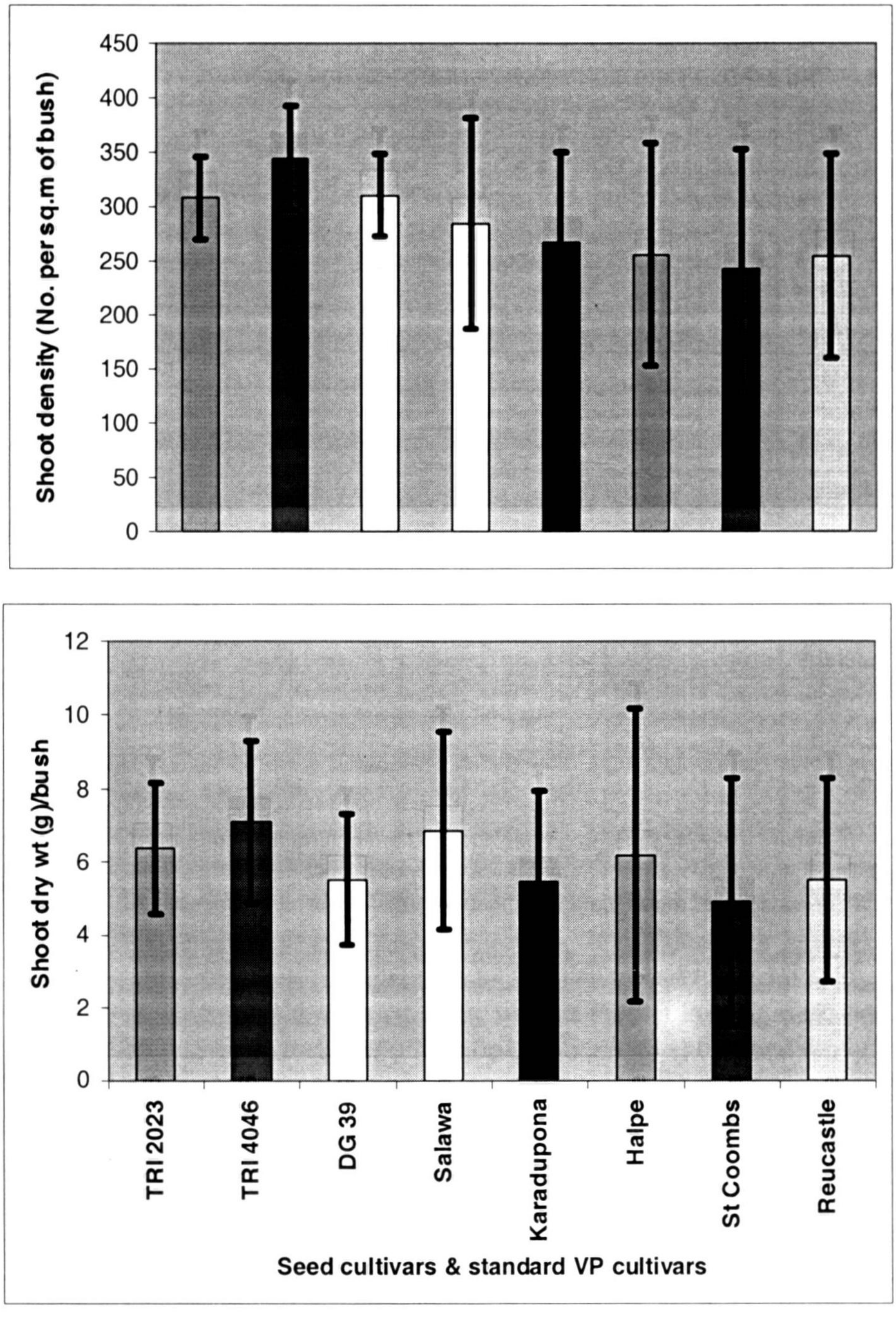

Fig. 1. Averages of yield components of seed progenies and VP cultivars.

The data in Fig. 1 clearly show that variability of yield components, among stands of VP cultivars, is much less than that of any of the seed cultivars tested. However, it should not be overlooked that the tea plant is highly heterozygous, and therefore seed populations may show great heterogeneity. Although uniformity of plants within a progeny is important, owing to the absence of homozygous lines in tea, the production of seedlings with morphological uniformity appears to be impractical (Kulasegaram, 1978; Portsmouth, 1954).

Among the promising seed progenies selected based on yield, the Salawa cultivars recorded the highest shoot density, ranking next to the VP cultivars. Further, the Salawa cultivars showed the highest shoot dry weights compared to all the other seed progenies tested. These results suggest that the Salawa seed cultivars would be outstanding in yield performance.

It has been proved that shoot density (number of shoots per unit area of the bush), and shoot weight, are the major factors that determine tea yield, and that more than 80% of the variation in tea yield is accounted for by these two yield components (Wijeratne, 1994). This substantiates the validity of the high average yield of the Salawa seed progeny and its outstanding performance.

Richards (1966) and Kulasegaram (1978,1980) stated that the progenies obtained from poly-clonal seed gardens are less predictable than those from bi-clonal mating. It was found that the range of variability in yield components was wider in bi-clonal progenies than in poly-clonal progenies., and a more promising performance in terms of morphological uniformity was observed in poly-clonal progenies, compared to bi-clonal progenies, in the present study.

The variation observed in the yield components among individual bushes, within a seed progeny, may be partly due to genetic variability (Wickramarathne, 1981 b). Hence, predicting the performance of seedling populations, in terms of biotic and abiotic stress tolerance, as can be done with VP cultivars, is virtually impossible because seedling populations consist of individuals with different genetic identities. Unless pure lines can be developed, which is an extremely difficult task in tea, seed will inevitably give a mixed population.

As a result, the progeny performance of populations derived from seeds varies, and may be quite inconsistent. It is advisable, therefore, to use promising seed stocks as an alternative source of planting material, especially in areas where extreme conditions prevail. It is also necessary to carry out commercial trials on multi-locations, prior to making a recommendation on the suitability of seed cultivars initially selected for commercial planting.

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