

Morphological Characterization of Newly Improved Tea (*Camellia Sinensis* L. O. Kuntze) Cultivars

U. D. R. E. Ruwanpura,
Uva Wellassa University, Badulla

M. A. B. Ranatunga
Tea Research Institute, Talawakelle

and

L. M. H. R. Alwis
Uva Wellassa University, Badulla

Introduction

Improved tea cultivars is one of the key determinants in facing emerging challenges of the tea industry such as high cost of production, declining land productivity, yield fluctuation due to adverse climatic effects and maintaining quality and quantity of the end product. In line with the breeding priorities Tea Research Institute (TRI) has developed its next series of cultivars which is going to be available for commercial planting in the near future. Agronomic trait evaluation of nine elite cultivars selected for up country tea growing region has completed and it is intended to characterize them for morphological descriptors before releasing them. Hence, this study was conducted with the objective of characterizing newly improved tea cultivars using internationally accepted standards and to distinguish the discriminating morphological attributes which are useful in identification of cultivars. This study was also aimed to formulate a vivid description of newly improved cultivars by preparing a cultivar catalogue.

Methodology

A total number of nine accessions (Code numbers 5, 15, 89, 101, 208, 210, 272, 497 and 582) were used in the study. For characterization, descriptors proposed by International Plant Genetic Resource Center (IPGRI) and International Union for the Protection of New Varieties of Plants (UPOV) have been used with the necessary adjustments related to the ratings to capture the variability present in the collection. Thirty, highly discriminating morphological descriptors as proposed by Wickramarathne, (1981), Gunasekara *et al.*, (2001) and Piyasundara, (2008) were used in characterization including 10 quantitative and 20 qualitative traits. Descriptive statistics for quantitative traits and Shannon Weaver Diversity Index (SWDI) for qualitative traits were calculated. Nine accessions were clustered using average linkage cluster analysis method.

Results and Discussion

As shown in the table 1, high variation was observed in quantitative traits among the accessions. Results revealed that all the quantitative parameters are significantly different among the cultivars (Table 2). Quantitative traits, leaf area, number of serrations, number of serrations per unit length and leaf width showed higher variation indicating high CV values such as 29.83, 19.36, 21.05 and 18.34 respectively. Leaf area ranged from 34cm² to 69 cm² with a mean of 46 cm². Number of leaf serration was ranging from 66 to 115 with a mean of 92 while number of serrations per unit length was in from 2 cm⁻¹ to 4 cm⁻¹ with mean of 3. Leaf width varied in the range of 4 cm to 7 cm with mean of 5 cm. Accession number 272 recorded the highest internodal length but, there is no significant difference between

accession number 5 and 272 for the internodal length. Out of nine accessions 5, 272 and 497 were emphasized as larger leaves with higher leaf areas. Further, there were no significant differences among them for the leaf area as well as in length of serrated margin. Accession number 5 was significantly different from other accessions recording the highest leaf angle whereas no significant difference between accession number 5 and 497 for the leaf pose. Moreover, the lowest leaf pose was recorded in accession number 89. When comparing the leaf length between the accessions the highest length was observed in accession no. 5 which was significantly different from the rest of the accessions. Further, the accession number 272 had the widest leaf, which was significantly different from the other accessions. The accession number 101 recorded the lowest width whereas the leaf length width ratio was highest in this accession. No significant difference was recorded between accession numbers 15, 89, 497 and 582 for number of serrations. Further, accession number 210 was recorded with the highest value for serrations per unit length and significantly different from other accessions.

Table 1: Descriptive statistics of quantitative traits

Quantitative trait	Mean value	Standard deviation (SD)	Range	Variance	Coefficient of variance (CV)
Internodal length(cm)	6.12	1.06	4.78 - 7.96	1.13	17.38
Leaf length(cm)	12.51	1.42	10.73 - 15.40	2.01	11.33
Leaf width(cm)	5.14	0.94	4.33 - 6.82	0.89	18.34
Leaf length: Leaf width	2.48	0.29	1.99 - 2.95	0.09	11.86
Leaf area(cm ²)	45.88	13.68	34.33 - 68.60	187.19	29.83
Length of serrated margin	29.04	3.53	25.32 - 34.40	12.43	12.14
No: of serrations	91.52	17.72	66.67 - 114.80	314.09	19.36
No: of serrations per unit length cm ⁻¹	3.19	0.67	2.30 - 4.45	0.45	21.05

Table 2: Means of quantitative traits

Trait Acc _no	Interno dal length	Leaf area	Leaf angle	Leaf pose	Leaf length	Leaf width	Leaf length : Leaf width	Length of serrated margin	Number of serrations	Serrations per unit length
5	7.52 ^a	68.60 ^a	63.50 ^a	90.90 ^a	15.40 ^a	6.04 ^b	2.56 ^{bc}	34.40 ^a	114.8 ^a	3.34 ^c
15	5.92 ^{bcd}	39.40 ^b	43.55 ^{de}	52.60 ^{ef}	12.10 ^{cd}	4.46 ^c	2.718 ^b	27.62 ^b	81.50 ^c	2.95 ^d
89	6.58 ^b	36.40 ^b	40.20 ^c	46.60 ^f	11.88 ^{cd}	4.55 ^c	2.63 ^b	26.73 ^b	81.67 ^c	3.06 ^d
101	4.78 ^c	35.80 ^b	45.80 ^{cde}	58.00 ^{cde}	12.77 ^{bc}	4.33 ^c	2.95 ^a	26.97 ^b	66.67 ^d	2.48 ^e
208	5.41 ^{cdc}	37.20 ^b	48.75 ^{bc}	65.55 ^{bc}	11.28 ^{de}	4.41 ^c	2.57 ^{bc}	27.03 ^b	105.9 ^b	3.93 ^b
210	6.04 ^{bc}	34.60 ^b	50.71 ^{bc}	69.71 ^b	10.73 ^c	4.60 ^c	2.34 ^d	25.32 ^b	111.83 ^{ab}	4.44 ^a
272	7.96 ^a	61.30 ^a	49.40 ^{bc}	61.95 ^{bc}	13.56 ^b	6.82 ^a	1.99 ^c	33.10 ^a	105.57 ^b	3.20 ^{cd}
497	5.78 ^{bcd}	61.50 ^a	54.30 ^b	83.95 ^a	13.23 ^b	6.19 ^b	2.14 ^c	33.45 ^a	76.83 ^c	2.29 ^e
582	5.10 ^{dc}	38.30 ^b	45.60 ^{dc}	56.10 ^{dc}	11.63 ^{dc}	4.83 ^c	2.41 ^{cd}	26.76 ^b	79.60 ^c	2.98 ^d

Means with the same letter are not significantly different.

Shanon Weaver Diversity index for qualitative traits were ranging from 0 to 1.06. According to SWDI the higher diversity was recorded for pubescence density of bud, leaf blade undulation of margin, serration of leaf margin, leaf shape, immature leaf colour whereas the SWDI in leaf waxiness, presence of pubescence in young shoot and leaf angle were recorded as the lowest indicating no or less diversity among the cultivars.

Table 3: Shanon Weaver Diversity Index (SWDI) of qualitative traits

Qualitative trait	SWDI	Qualitative trait	SWDI
Density of pubescence of bud	1.06	Type of serration of leaf margin	0.64
Undulation of leaf margin	1.06	Leaf apex habit	0.53
Leaf blade serration of margin	1.00	Mature leaf colour	0.53
Leaf blade shape	0.85	Leaf pose	0.53
Immature leaf colour	0.85	Branch zigzagging	0.35
Leaf blade attitude	0.68	Leaf venation	0.35
Leaf blade texture of upper surface	0.68	Waviness of leaf lamina	0.35
Anthocyanin coloration of base of the petiole	0.67	Presence of young shoot pubescence of bud	0
Leaf apex shape	0.67	Leaf waxiness	0
Leaf base shape	0.64	Leaf angle	0

Dendrogram constructed (Figure 1) separated cultivars in to three major clusters. The first cluster comprised of two cultivars 497 and 582 and formed a unique clusters at 1.5 average distances. Both the cultivars have recorded same leaf blade shape in the apex, the shape of the base and the mature leaf colour.

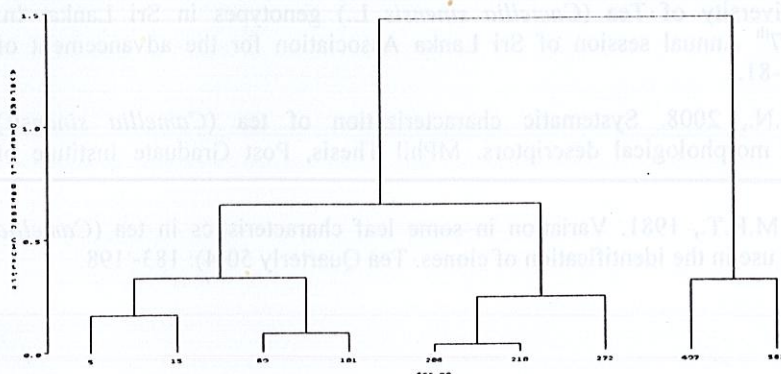


Figure 1: Dendrogram of morphological attributes, of newly improved tea cultivars

The second cluster comprised of three accessions 208, 210 and 272 which are having similar leaf apex shape, immature leaf colour and mature leaf colour. Furthermore, accession no. 208 and 210 were recorded with high similarities, *i.e.* absence of anthocyanin pigmentation, upwards in leaf blade attitude, acute in leaf apex shape and elliptic in shape of the leaf blade.

The largest cluster consisted of accession numbers 5, 15, 89 and 101. Three of them were inherited from maternal parent TRI 777. According to Wickramaratne (1981) TRI 777 resembles to China type tea with characteristic high leaf length: leaf width ratio. Similarly, accession numbers 15, 89 and 101 have higher ratio of leaf length and leaf width indicating prominent maternal inheritance of TRI 777. Accession number 5 was developed from TRI 2025 and consisted with broad leaves similar to mother plant but leaves were folded

upwards in nature. In this cluster all four accessions are having straight leaf apex habit and moderately rugose leaf upper surface. Further, all the accessions in this cluster attributed with elliptic shape in the leaf blade and the acute shape at the leaf base.

A preliminary cultivar identification guide was prepared with these 18 quantitative and qualitative traits as discriminating descriptors and validated using a seven panelist. More than 90% of the accessions were identified by them using the guideline prepared indicating practical feasibility of using the guideline in cultivar identification.

Conclusion

In the first attempt to characterize newly improved tea cultivars using morphological traits wide phenotypic diversity was observed among cultivars. Highly varied quantitative traits viz intermodal length, leaf width, leaf length: width ratio, leaf area, length of serrated margin, number of serrations and number of serrations per unit length and some of the qualitative traits viz density pubescence of bud, leaf blade undulation of margin, leaf blade serration of margin, leaf blade shape, immature leaf colour are the most discriminating characters in cultivar identification which are used to develop a preliminary cultivar identification guide. This preliminary cultivar identification guide developed in this study can be used to identify new cultivars.

References

- Gunasekara, M. T. K., Arachchi, J. D. K., Mudalige, A. K., Peiris, T. U. S., 2001. Morphological Diversity of Tea (*Camellia sinensis* L.) genotypes in Sri Lanka, In: Proceedings of 57th Annual session of Sri Lanka Association for the advancement of Science 70(2): 69 -81.
- Piyasundara, J.H.N., 2008. Systematic characterization of tea (*Camellia sinensis*) germplasm using morphological descriptors. MPhil Thesis, Post Graduate Institute of Agriculture.
- Wickramaratne, M.R.T., 1981. Variation in some leaf characteristics in tea (*Camellia sinensis*) and their use in the identification of clones. Tea Quarterly 50(4): 183- 198.