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Genetic variability studies on yield related characters of tea (*Camellia* spp.) genotypes

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Tea is an evergreen plantation crop widely grown from tropical to temperate region in Asia. It has been closely associated with people's life as one of the best beverages. In view of the increase in tea consuming population and people's preference, the basic objective of the plant breeders would always be improvement in yield and quality. In recent years, much emphasis is being given for commercial exploitation of clones with high yield and quality. However, most of the tea growing areas at present is under seedling population with an average productivity of 1750 – 2000 kg made tea/ha (Anon. 2006). Therefore, there is a need to pay immediate attention for raising present yield levels by planting uniformly high yielding clones or biclonal seed stocks. To achieve genetic improvement in yield traits, it is imperative to generate information on variability, its heritable portion and also inter relationship existing in the material handled. The old seedling population is critical for success of the selection and breeding programme. The present investigation was undertaken with 34 diverse tea populations to study various genetic parameters so as to formulate effective selection criteria to isolate clones with high yielding potential.

An evaluation of 34 diverse genotypes collected from different tea growing gardens of South India was carried out in a randomized block design with two replications at the germplasm bank, UPASI Tea Research Institute, Valparai during 2005–06. The observations were recorded on five randomly selected plants in each replication for traits such as number of branches per plant, stem girth (cm), leaf length (cm), leaf breadth (cm), shoot length (cm), inter nodal length (cm), number of shoots per plant, fresh weight of shoot (g), dry weight of shoot (g) and yield (g). The data collected were analysed statistically for variability using range, mean, standard deviation (Singh and Choudhary, 1995), Phenotypic Coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV) (Burton and Devane, 1953), heritability broad sense (h^2), genetic advance (GA) (Jain, 1982), genetic advance as per cent mean (Johnson *et al.,* 1955) and phenotypic correlation coefficient by the method suggested by Goulden (1952).

The analysis of variance revealed significant differences among the genotypes for each character, indicating the existence of variability among the genotypes studied (Table 1). The data for mean, range and coefficient of variation of the characters studied indicated that the traits can be improved through effective selection method (Table 2). The genetic parameters obtained from the analysis are presented in Table 3. In general the PCV was higher than the GCV value for all the traits studied. The difference between GCV and PCV for characters such as number of branches/plant, stem girth, leaf length, leaf breadth and number of shoots/plant was high indicating the influence of environment and point out the limited scope for selection for these traits. Whereas, the relative magnitude of difference was low for characters such as shoot length, fresh weight of shoot, dry weight of shoot and yield/plant/plucking indicating the low degree of environmental influence. These characters offer much scope for improvement by selection.

Table 1. Analysis of variance for yield and yield related character of 34 accessions

Characters	Replication	Genotype	Error
Number of branches/plant	0.058	13.45**	1.60
Stem girth (cm)	0.0559	4.94**	0.61
Leaf length (cm)	0.99	5.94**	1.65
Leaf breadth (cm)	0.30	1.13**	0.20
Shoot length (cm)	0.10	7.10**	0.47
Inter nodal length (cm)	0.04	1.61**	0.09
Number of shoots/plant	14.13	55.91**	4.92
Fresh weight of shoot (g)	0.001	0.95**	0.005
Dry weight of shoot (g)	0.0001	0.04**	0.0003
Yield/plant/plucking (g)	0.07	604.08**	0.11

**Significant at 1% level

Table 2. Variability in yield and yield related character of 34 accessions

Characters	Mean ± SE	Range	CV %
Number of branches/plant	7.5 ± 1.26	3 - 14	16.89
Stem girth (cm)	7.24 ± 0.78	4.4 - 10.9	10.78
Leaf length (cm)	12.45 ± 1.28	8.4 - 16.6	10.32
Leaf breadth (cm)	5.29 ± 0.45	4.0 - 7.4	8.49
Shoot length (cm)	11.34 ± 0.68	8.9 - 16.3	6.08
Inter nodal length (cm)	3.55 ± 0.29	2.45 - 6.20	8.39
Number of shoots/plant	15.28 ± 2.21	10.0 - 29.5	14.52
Fresh weight of shoot (g)	2.09 ± 0.07	1.33 - 4.94	3.35
Dry weight of shoot (g)	0.38 ± 0.01	0.26 - 0.94	3.68
Yield/plant/plucking (g)	30.24 ± 3.6	9.15 - 108.7	11.2

A higher estimate of heritability was recorded in almost all the characters. High heritability coupled with high genetic advance as per cent of mean was observed for the traits yield, dry weight of shoot, fresh weight of shoot, number of shoots per plant and number of branches per plant indicating the role of additive gene action in governing these characters. These findings offer further scope for improvement through selection. Whereas, the traits such as leaf length and leaf breadth registered high heritability estimates coupled with moderate genetic advance as per cent mean confirming the role of both additive and non additive gene actions implied limited scope for improvement through selection.

The analysis undertaken to study the association (Table 3) between yield and other traits revealed that except number of branches on the plant and stem girth, all the traits registered high positive and significant correlation. Earlier workers have reported that dry and fresh weight of shoot (Satyanarayana and Sharma, 1981) and number of shoots per plant (Nyirenda and Ridpath, 1980; Sharma and Ranganathan, 1986) also recorded high association with yield.

Table 3. Genetic parameters and correlation for yield and yield related characters in tea

Characters	GCV (%)	PCV (%)	h2 (%)	GA	GA % mean	r - value
Number of branches/plant	32.45	36.58	78.69	4.45	59.30	0.11
Stem girth (cm)	20.31	23.00	78.02	0.07	36.97	0.11
Leaf length (cm)	11.75	15.64	56.49	2.80	18.20	0.49**
Leaf breadth (cm)	12.86	15.41	69.66	0.00	22.11	0.67**
Shoot length (cm)	16.04	17.15	87.45	2.61	30.91	0.48**
Inter nodal length (cm)	24.53	25.92	89.53	2.83	47.82	0.58**
Number of shoots/plant	33.04	36.09	83.82	1.32	62.32	0.67**
Fresh weight of shoot (g)	32.96	33.13	98.97	11.41	67.56	0.79**
Dry weight of shoot (g)	35.28	35.54	98.53	3.38	72.14	0.81**
Yield/plant/ plucking (g)	58.31	59.56	95.87	4.52	117.62	-

** p value = 0.01

The overall results from the study indicated that dry weight of shoot, fresh weight of shoot and number of shoots/plant exhibited high phenotypic coefficient of variation, heritability coupled with high genetic advance as per cent mean. Interestingly, these three components also had highly significant positive correlation with yield. Therefore, improvement in yield could be achieved by exercising selection pressure on these characters.

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