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GENETIC VARIABILITY AND G x E INTERACTION FOR YIELD COMPONENTS IN SEED AND CLONAL CULTIVARS OF TEA (*CAMELLIA SINENSIS* L.)

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ABSTRACT

Genotype x environment (G x E) interaction and genetic variability for yield components viz. fresh weight, dry weight and volume of two and a bud shoots were studied in 9 seed and 28 clonal cultivars of tea over three different seasons. Seed stocks recorded lower mean values of yield components than clones. Variance due to seasons and genotypes (seed stocks and clones) were highly significant. Significantly high G x E interaction in clones revealed the need for testing the clones over different environments. Seed stocks showed higher genetic variability than clones for yield components.

Key words: Variability, G x E interaction, yield components, tea.

Commercial tea is produced from young shoots of tea bushes. Generally, two leaves and a bud together are plucked from tea bushes and then processed in the factory to produce made tea of commerce. Yield of made tea depends on yield components, viz. fresh weight, dry weight and volume of young shoots. Higher the dry weight, greater is the yield of made tea. Moisture content of young fresh shoots determines the time required in the withering process during tea manufacture. The volume influences the efficiency of plucking. Genetic improvement of these traits depends on the nature and extent of their genetic variability. However, no information is available on the genetic variability of yield components in tea [1]. Therefore, the present investigation has been taken to study the nature of G x E interaction and genetic variability of fresh weight, dry weight and volume of two and a bud shoots in seed stocks and clones.

MATERIALS AND METHODS

The experiment was conducted at the Tocklai Experimental Station, Jorhat, Assam, during three seasons, i.e., early (June–July), main (August–September) and backend

(October–November) seasons of 1993. Total 37 genotypes comprising 9 seed stocks and 28 clones (Tables 1 and 2) were examined separately in randomized block design with three replications for each genotype at 105 x 60 x 75 cm spacing. Each plot had 32 bushes. Mean data for fresh and dry weight and volume of 50 two-and-a-bud shoots (i.e. apical shoots) were recorded.

Fresh weight and volume of 150 apical shoots of each genotype were measured immediately after plucking. The shoot volume was measured following Archimedes' principle [2]. The same 150 fresh shoots were dried in oven for 36 hrs at 105°C to record their dry weight.

The data were used for combined analysis of variance [3]. Phenotypic and genotypic coefficients of variation (PCV, GCV) for fresh weight, dry weight and volume of shoots in the seed stocks and clones were calculated separately according to Burton [4]. Broad sense heritability and expected genetic advance at 10% selection intensity were calculated as per Johnson [5].

RESULTS AND DISCUSSION

Average fresh weight of a two-and-a-bud – apical shoot in seed stocks (0.44 g) was lower than that in clones (0.59 g) (Tables 1, 2). High fresh weight in the clones was due to their selection from the parent seed stocks for desired characters. The average dry weight, again, was lower in the seed stocks (0.09 g) than in clones (0.12 g). In the case of shoot volume also, the seed stocks (0.48 cc) showed lower value than clones (0.63 cc).

Table 1. Mean fresh weight, dry weight and volume of two-and-a-bud (apical) shoot in different seed stocks of tea

Seed stock	Fresh weight (g)	Dry weight (g)	Volume (cc)
TS 379	0.37	0.08	0.41
TS 449	0.41	0.09	0.44
TS 450	0.38	0.08	0.40
TS 462	0.39	0.08	0.42
TS 463	0.46	0.10	0.50
TS 464	0.37	0.08	0.41
TS 491	0.62	0.13	0.67
TS 506	0.43	0.09	0.46
TS 520	0.55	0.11	0.60
Average	0.44	0.09	0.48

Combined analysis of variance (Table 3) for fresh weight, dry weight and volume in seed stocks and clones showed that the seasons differed significantly indicating thereby differences in different growing seasons. Variance due to genotypes was highly significant for all the traits, suggesting that the seed stocks and the clones separately were genetically diverse within themselves for these traits. The genotype x seasons (G x S) interaction effect was significantly only in the case of fresh weight and not for other traits in seed stocks. But the clones showed highly significant G x S interaction for fresh weight, dry weight and shoot volume, suggesting that they were more sensitive to the environmental changes than seed stocks. This means that the seed stocks have a broader genetic base and, therefore, can adapt easily to the environmental changes. But the clones with narrow genetic base due to selection cannot adapt easily and are more sensitive to environmental fluctuations, thereby showing significant G x S interaction. In the clones, significant G x S interaction is of great advantage to the tea industry because a clone will give higher yield in favourable season. Such interaction reduces the correspondence between genotype and phenotype, thereby making selection of superior clones difficult. The clones have to be tested over several environments before selecting a suitable clone with desirable characters for cultivation. It is, therefore, essential to keep such G x S interaction under consideration while selecting clones [6].

FRESH WEIGHT

The genetic analysis for fresh weight (Table 4) revealed that the phenotypic variance was higher than the corresponding genotypic variance in both seed stocks (25.7 and 18.1) and clones (42.8 and 10.6). This again indicates significant influence of environment on fresh weight.

Phenotypic coefficient of variation (PCV) was almost similar in seed stocks (22.7) and clones (22.1). But genotypic coefficient of variation (GCV) was higher in seed stocks (19.1) than clones (11.0) suggesting broad genetic base, hence wide adaptability of seed stocks as compared to clones.

Seed stocks showed high heritability (72.8) coupled with genetic advance (29.1) whereas

Table 2. Mean fresh weight, dry weight and volume of two-and-a-bud (apical) shoot in different clones of tea

Clone	Fresh weight (g)	Dry weight (g)	Volume (cc)
TV 1	0.59	0.12	0.63
TV 2	0.57	0.11	0.63
TV 3	0.59	0.12	0.63
TV 4	0.53	0.10	0.59
TV 5	0.78	0.15	0.85
TV 6	0.68	0.13	0.75
TV 7	0.40	0.08	0.43
TV 8	0.59	0.12	0.66
TV 9	0.53	0.10	0.56
TV 10	0.46	0.09	0.49
TV 11	0.61	0.12	0.66
TV 12	0.66	0.14	0.71
TV 13	0.64	0.13	0.69
TV 14	0.52	0.11	0.57
TV 15	0.57	0.12	0.61
TV 16	0.57	0.12	0.61
TV 17	0.48	0.11	0.52
TV 18	0.48	0.10	0.50
TV 19	0.72	0.16	0.77
TV 20	0.59	0.12	0.64
TV 21	0.74	0.15	0.79
TV 22	0.73	0.14	0.80
TV 23	0.58	0.12	0.61
TV 24	0.69	0.13	0.74
TV 25	0.55	0.11	0.54
TV 26	0.54	0.11	0.53
TV 27	0.59	0.11	0.62
TV 28	0.61	0.11	0.62
Average	0.59	0.12	0.63

Table 3. ANOVA (sum of squares) for fresh weight, dry weight and volume of 150 two-and-a-bud (apical) shoots in seed stocks and clones of tea

Source	d.f.		Fresh weight		Dry weight		Volume	
	seed stocks	clones	seed stocks	clones	seed stocks	clones	seed stocks	clones
Replications	6	6	6.5	4.6	0.3	0.2	9.1	5.9
Seasons (E)	2	2	241.5**	4052.0**	13.5**	205.5**	277.0**	4112.1**
Genotypes (G)	8	27	175.0**	177.8**	5.5**	6.8**	199.2**	225.4
G x E	16	54	11.8*	82.3**	0.3	2.9**	12.1	76.7**
Error	48	162	5.5	7.1	0.3	0.3	6.8	9.6

*,**Significant at 5% and 1% levels, respectively.

clones exhibited low heritability (24.8) with low genetic advance (9.7). This suggests greater heritable variance in seed stocks for fresh weight and, therefore, greater scope of plant improvement through selection in seed stocks. But low heritability coupled with low genetic advance in clones revealed limited scope for improvement of fresh weight through selection.

DRY WEIGHT

Like fresh weight, PCV for dry weight (Table 4) was higher than GCV in both seed stocks (0.9 and 0.6) and clones (1.6 and 0.4). PCV was almost similar in seed stocks (19.5) and clones (21.2) but GCV was relatively higher in seed stocks (16.3) than clones (11.1) which indicates broader genetic base and wider adaptability of seed stocks than clones for dry weight.

Seed stocks showed high heritability (69.4) with high genetic advance (23.9) for dry weight whereas clones showed low heritability (27.7) with low genetic advance (10.3). Therefore, selection could be practised on seed stocks for improving dry weight.

VOLUME

Like fresh weight and dry weight, the volume of apical shoots (Table 4) showed higher PCV than GCV in both seed stocks (29.4 and 20.8) and clones (48.5 and 16.5), which indicates the influence of environment on shoot volume. PCV was almost similar in seed stocks (22.6) and clones (20.0), but GCV was relatively higher in seed stocks (19.0) than in clones (12.8). This confirms wider genetic variability and greater adaptability for shoot volume in the seed stocks than in the clones. Seed stocks also showed high heritability (69.8) for volume with high genetic advance (13.2). Like fresh weight and dry weight, shoot volume could be improved through selection in the seed stocks.

Table 4. Analysis of genetic parameters for fresh weight, dry weight and volume of 150 two-and-a-bud (apical) shoots in seed stocks and clones of tea

Group of genotypes	Population mean ± SE	Phenotypic variance	Genotypic variance	PCV	GCV	Herit-ability (%)	Genetic advance (% of mean)
			Fresh weight				
Seed stocks	22.3 + 1.7	25.7	18.1	22.7	19.1	72.8	29.1
Clones	29.6 + 1.2	42.8	10.6	22.1	11.0	24.8	9.7
			Dry weight				
Seed stocks	4.7 + 0.3	0.9	0.6	19.5	16.3	69.4	23.9
Clones	5.9 + 0.2	1.6	0.4	21.2	11.1	27.7	10.3
			Shoot volume				
Seed stocks	24.0 + 1.8	29.4	20.8	22.6	19.0	69.8	27.7
Clones	31.7 + 1.3	48.5	16.5	22.0	12.8	34.1	13.2

Fresh weight, dry weight and shoot volume represent the size of tea shoots. Genetic analysis of these three characters in seed stocks and clones showed similar trends for PCV, GCV, heritability and genetic advance. Therefore, any of these three characters could be used as a selection criterion for yield improvement. However, since fresh weight of shoots can be measured easily compared to dry weight and volume, therefore, it may be taken as a selection criterion.

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