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TAXONOMIC STUDY OF TEA CULTIVARS, CALTIVATED IN PAKISTAN BY USING MORPHOGENETIC APPROACH

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Abstract

Tea (*Camellia sinensis* (L.) O. Kuntze is the most consumed beverage in the world. Six genotypic cultivars of tea, namely Indonesian, Sri Lankan, Ruopi, Qi men, Chuye and Japanese were taxonomically characterized by using morphogenetic approach. Randomized Completely Block Design (RCBD) technique was applied in the analysis and results were presented in form of phenogram. Taxonomically genotypes were divided into two clusters with genetic distance (GD) 4.5. The cluster-I contained four cultivars bifurcating into two sub-linages with difference of GD 3. Intra-cluster GD of between genotypes Japanese and Sir Lankan was 2.0 GD and Chuye and Ruopi genotypes were closely associated with 1.8 GD. The cluster-II indicated the trait homology between Indonesian and Qi Men populations was 1.4 GD. This demonstrates that Qi men and Indonesian genotype are genetically more closely related than other genotypes, may be originated from one ancestor. The qualitative character evaluation was conducted to explore adaptability of these genotypes to the environment. The vein pairs per leaf was highest in Indonesian (13.60), followed by Qi men (12.08). The internode distance was highest in Qi men (3.7 cm) succeeded by Ruopi (3.6 cm). The branch angle to stem value was 35° in Qimen followed by Japanese with 38°. This morphogenetic analysis shows that Qimen and Sri Lankan genotypes are congruently adapted to the environment which depicts that area is appropriate for the tea plant growth and cultivation. This analysis also reflects that although these tea cultivars are phenetically similar to each other but can be differentiated by use of numerical analysis.

Key words: Tea cultivars; Taxonomy; Morphometrics; Shankiari; Plant growth.

Introduction

Tea (*Camellia sinensis* (L.) O. Kuntze, locally called "Chai" belongs to family Theaceae that is the most consumed beverage in the world (Eden, 1958; Mukhtar & Ahmed, 2000). The genus *Camellia* has 82 species (Sealy, 1958) and accounts for more than 325 subspecies and 600 varieties that indicate genetic instability and high out-breeding nature of the genus (Mondal, *et al.,* 2002). Tea contains many chemicals such as carotene, riboflavin, nicotinic acid, pantothenic acid and ascorbic acid. Caffeine and tannin are among the more active constituents (Chen *e al*., 2005; Ming, 2000; Anon., 1976).

The components of tea include catechins, polyphenols, and other antioxidants which are termed "nonnutrient" or "chemopreventive agents" that may reduce the risk of cancer (Dreosti, 1996; Zahid *et al*., 2009). Dried and cured leaves widely are used for beverage which has a stimulant effect due to caffeine. Tea extract is used as a flavor in alcoholic beverages, frozen dairy desserts, candy, baked goods, gelatins, and puddings (Leung, 1980; Zahid *et al*., 2009). Air-dry tea seed yields clear golden-yellow oil resembling sasanqua oil, but the seed cake, containing saponin, is not suitable for fodder. Refined tea seed oil, made by removing the free fatty acids with caustic soda, then bleaching the oil with Fuller's earth and a sprinkling of bone black, makes an oil suitable for use in manufacture of sanctuary or signal oil for burning purposes, and in all respects is considered a favorable substitute for rapeseed, olive, or lard oils. Tea used as folk reputation as analgesic, antidotal, astringent, cardio tonic, carminative, CNS stimulant, demulcent, deobstruent, digestive, diuretic, expectorant, lactagogue, narcotic, nervine, refrigerant, stimulant, and stomachic; used for bruises, burns, cancer, cold, dog bite, dropsy, dysentery, epilepsy, eruptions, fever, headache, hemoptysis, hemorrhage, malaria, ophthalmia, smallpox, sores, toxemia, tumors, and wounds (Duke, & Wain, 1981).

The ecological requirements of Tea ranges from Warm Temperate Dry to Wet through Tropical very Dry to Moist Forest Life Zones; Tea is reported to tolerate annual precipitation of 7 to 31 dm, annual temperature of 14 to 27°C, and pH of 4.5 to 7.3. Although evergreen, tea is intolerant of frost, and requires equable, humid, warm situations; some Chinese tea varieties can tolerate cooler climates. Tea thrives on tropical red earths and deep, well drained, acidic soils (pH 4.5-6.0). Mean minimum temperatures should not fall below 13°C, or maximum above 30°C. An annual rainfall of 120 cm or more is desirable. Several months with less than 5 cm rainfall each are intolerable for tea growth and production (Grey & Matthews, 1983).

Pakistan Agriculture Research Council (PARC) initiated Tea program in Baffa in 1976-77 and after that in 1982 PARC also start tea cultivation in Battal, Devily while later invited Chinese Experts in 1982 and 1987-88 who surveyed the prospective areas for tea cultivation and identified about 64000 ha of land with good to moderate potential reported by Thardeep Rural Development Programme (TRDP) (Annon, 1998-2006; Kaundun & Park, 2002). Through the research efforts suitable varieties were identified, nursery-raising techniques developed, and plantation was established on

43 acres. Now present area reached to about 525 acres. In 2001, Black Tea Processing Plant at National Tea and High Value Crops Research Institute (NTHRI) was established (Waheed, *et al.,* 2002, Shah & Khan, 2004). Pakistan imported 72231.52 metric tons (MT) black tea at a value of US$ 134.288 million during July – March 2006-07 as compared to 93657.46 MT imported in the corresponding period last year at a value of US$ 151.622 million, registering a 3.46 percent decline in the import. The production of 2006-07 processed black teas in Pakistan was 5797 Kg (Anon., 2007; Mishra, & Sen-Mandi. 2001).

Mong *et al.* (2006) studied the taxonomic position of the 'Taiwanese wild tea' has been called the "tea of the gods" and explored relationship with two closely related taxa, *C. sinensis* var. *sinensis* and *C. sinensis* var. *assamica*, 16 vegetative and 11 floral characters were examined. They analyzed data by using cluster analysis and nonlinear principal components analysis. All cluster phenograms consistently separated the native wild tea plant from two other related taxa. Conversely, pronounced admixture between *C. sinensis* var. *sinensis* and *C. sinensis* var. *assamica* was present. The nonlinear principal components analysis indicated that the surface features of buds and ovaries were two diagnostic characters. Saravanan *et al.* (2005) identified the genetic diversity in selected 26 UPASI released tea clones. Principal component analysis (PCA) based on regression factor separated tea clones into five groups according to their jats (Jats are region based rays for e.g., Assam, China and Cambod origin) as well as their quality constituents (such as total polyphenols, total catechins, amino acids in the green leaves and liquor characteristics of black tea), particularly the catechins. This biochemical differentiation indicated that there is a vast genetic diversity in UPASI released tea clones in terms of catechin fractions, even though the majority of them were selected from one tea estate located in the Nilgiris.

Thai & Heiko (2004) assessed morphological diversity in tea varieties. Due to high diversity in tea provides the basic information for tea breeding aiming to build up a set of regionally adapted tea populations and clones. All tea taxa freely interbreed and therefore tea plants with many overlapping morphological, biochemical and physiological attributes are highly diverse and consequently their populations are very heterogeneous (Wachira *et al*., 2001).

Tapan (2004) concluded advancements of molecular biology overcome these problems, for identification of superior cultivars; these markers are greatly influenced by environmental factors and show a continuous variation with a high degree of plasticity. But now efforts have shifted to use various DNA markers. Understanding genetic diversity at the molecular level of tea germplasm will help to improve tea varieties for agronomically important characteristics through marker assisted selection. Kumar (2002) analyzed 25 diverse tea *Camellia sinensis* (L.) cultivars by using the simple sequence repeat anchored polymerase chain reaction (SSR-anchored PCR) or Inter SSR-PCR (ISSR) (Wachira *et al*., 2001; Mishra *et al.,* 2001). Out of the 45 primers 12 were chosen for final study. These amplified a total of 130 bands out of which 108 (84%) were polymorphic. Consequently, biotechnological tools appear to be the ideal choice to circumvent problems of conventional tea breeding.

A research based on cytomorphological characteristics of tea species in Pakistan conducted by using chromosomal data (Rahman *et al.,* 2010). They described that cytological attributes could be used to generate more germplasm if the two species could be involved in tea breeding programs. Naheed *et al.,* 2007 has conducted research on processing of tea products. They demonstrated that rolling, fragmentation and drying do have impact on final quality of tea. Hence, its taste is varied by fluctuation of these factors, so paramount care should be imparted to keep quality at unisonic standard by reducing variance among these factors.

Albeit, different cultivars are tried and cultivated in our country but hitherto there is plethora that it is not proved that which genotypes are better adaptable to the environment of Pakistan. Secondly, there is pertinent intricate problem to differentiate and identify these cultivars. The main objectives of this study were: (i) to document morphological characteristics of tea genotypes and use numeric method for identification and classification purpose and, (ii) to recommend the best cultivar which is best acclimatize to the local climate of Shankiari for better yield.

Martial and Method

For analysis healthy, disease free and morphologically similar plant samples were collected from green house of national tea research institute (NTRI) at Shankiari. Triplicate samples were randomly collected from six genotypes named: Indonesian, Sri Lankan, Ruopi, Qimen, Chuye and Japanese and stable and constant phenetic characters were documented for numerical matrix and statistical evaluation. The experimental was based on Randomized Completely Block Design (RCBD) pattern for unbiased experimentation. The qualitative data was compiled based on phenetic characters of plant leaf pose, leaf lower sides color, leaf upper sides color, leaf shape, leaf apices, leaf base, leaf margin and shoot color. Tabulated data of tea germplasm was analyzed by using taximetrics technique employing Wards Method (WM). Whereas quantitative values were measured including lamina length, lamina breadth, length to breadth ratio, vein pairs per leaf, leaf area, fresh leaf weight, dry leaf weight, internodes distances, branch angle to stem, shoot length, leaves at shoot and seed weight. The collected data was formulated in form of excel matrix and analyzed by using the software M STAT-C in phenogram form, for taxonomic identification and classification.

Results

Tea being is amateur and medicinal drink in the most part of the country. It is equivocally popular in urban and rural communities. Data pertaining to different morphological and yield characters are presented in the form of tables and figures. The mean values for the qualitative characters were measured and data matrix was constructed (Tables 2 and 3) and the formulated table was analyzed which resulted in the form of phenogram depicting the trait homology (Fig. 1). For qualitative character analysis, the results show that qualitative characters such as lamina length and breadth, length to breadth ratio, vein pairs per leaf, leaf area, fresh leaf weight, dry leaf weight, internode distances, branch angle to stem, shoot length, leaves at shoot and seed weight are highly significant. The Qi men showed lowest value of lamina length (8.10 cm) followed by Ruopi (8.37 cm) (Table 2). For lamina breadth Chuye showed lowest value (3.32 cm), followed by Ruopi and Qi men i.e. (3.41 cm) and (3.51), respectively (Table 2). Chuye and Ruopi showed the highest value for length to breadth ratio (2.55), followed by Qi men (2.31) (Table 2). The highest value for vein pairs per leaf showed by Indonesian (13.60), followed by Qimen (12.08) (Table 2). Lowest leaf area value showed by Ruopi (23.53cm^2), followed by Chuye (28.28 cm^2) and Qimen (28.65 cm^2) (Table 2). In case of fresh leaf weight highest value showed by Indonesian (1.06 g) which is followed by Sir Lankan (0.63 g) (Table 2). Highest dry leaf weight value showed by Indonesian (0.44 g) followed by Sir Lankan (0.24 g) (Table 2). Lowest value of Internodes distances showed by Ruopi (3.6 cm), followed by Qimen (3.7 cm) (Table 3). The minimum value of branch angle to stem showed by Qimen 35.0° which is followed by Japanese i.e. 38.0° (Table 3). Qimen showed the minimum value of shoot length (3.80 cm), followed by Chuye (5.62 cm) (Table 3). Qimen showed the average leaves at shoot (2.4) and average seed weight i.e. 1.32 g (Table 3).

The cluster analysis is very effective method to classify the germplasm of different species on the basis of traits homology (Nisar *et al.,* 2008). In the present research, the data were subjected to Wards Method (WM) which clearly sorted the whole germplasms of tea into two main clusters and two sub-groups based on qualitative traits analysis. Cluster-1a indicates the trait homology between Japanese and Sir Lankan varieties and their trait homology is for leaf margin, leaf base and shoot color is presented in Table 1 and the genetic distance (GD) of their homology is 2.0 GD (Fig 1). Cluster-1b indicates the trait homology between Chuye and Ruopi genotypes and they depict fair trait homology in leaf margin, leaf pose, leaf lower surface, shoot color (Table 1) and they demonstrated homology value of 1.7 GD (Fig 1).

While Cluster-II indicates the trait homology between Indonesian and QiMen genotypes and their trait homology in leaf shape, leaf margin, leaf lower surface, leaf upper surface, shoot color, leaf apices, and posture of leaf base is presented in Table 1 and their homology values is1.4 GD (Fig. 1). There is exclusive difference between the intra-cluster and inter-clusters values of LD as depicted by analysis of data in form of Fig. 1. The intra-clusters values with 3 GD show more similarity between genotypes of group 1-a (Japanese & Sir Lankan) and 1-b (Chuye & Ruopi) while the inter-cluster values of GD are higher (4.5) which demonstrate that genotypes Inodnesian and Qi Men are well distinctive from other four cultivars (Fig. 1).

Table 1. Cluster analysis tea germplasm based on phenotypic evaluation using wards method.

Groups	Cluster	Members	Traits homology
Group 1	Cluster-1a	Japanese Sir Lankan	Leaf margin, leaf apices, shoot color, leaf margin, leaf pose, leaf lower surface, shoot color
	Cluster-1b	Chuye Ruopi	Leaf margin, leaf apices, shoot color, leaf margin, leaf pose, leaf lower surface, shoot color
Group 2	Cluster-2	Indonesian Qi Men	Leaf shape, leaf margin, leaf lower surface, leaf upper surface, leaf apices, posture of leaf base

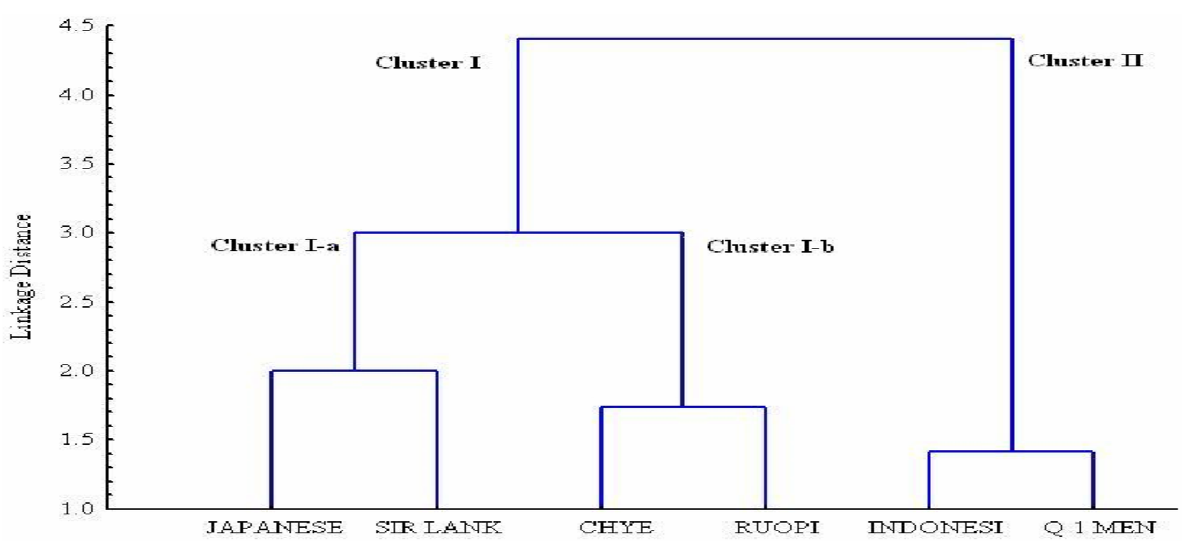

Fig. 1. Cluster analysis of Pakistani tea germplasm based on qualitative traits analysis using Wards Method.

Table 2. Means for leaf character in six tea genotypes.

S. No.	Genotype	Lamina length (cm)	Lamina breadth (cm)	Length/ breadth ratio	vein pair	Leaf area (cm²)	Fresh leaf Wt (g)	Dry leaf wt(g)
1.	Qi Men	8.100 c	3.512 c	2.310 bc	12.08 ab	28.65 c	0.4320 bc	0.172 bc
2.	Ruopi	8.376 c	3.412 c	2.552 a	11.24 b	23.53 c	0.3640 c	0.1260 c
3.	Indonesian	11.70 a	5.696 a	2.050 d	13.60 a	66.91 a	1.060 a	0.4420 a
4.	Sir Lankan	9.620 b	4.296 b	2.238 cd	10.72 b	41.49 b	0.6320 b	0.2460 b
5.	Japanese	9.036 bc	3.572 c	2.468 ab	11.80 b	32.37 c	0.4480 bc	0.176 bc
6.	Chuye	8.492 c	3.320 c	2.550 a	10.76 b	28.28 c	0.3500 c	0.1220 c
	LSD value	**0.9978**	**0.5127**	**0.2086**	**1.524**	**8.772**	**0.1912**	**0.08344**

**Significant at 1% probability level
Note: Each value is a mean of five replications

Table 3. Mean squares and coefficient of variation (CV) for Shoot and seed character in six tea genotypes.

S. No.	Genotype	Inter node distances (cm)	Branch angle to stem (degree)	Shoot length (cm)	Leaves at shoot (No.)	Seed Wt. (g)
1.	Qi Men	3.740 b 35.00 d	35.00 d	3.800 b	2.4 ab	1.328 b
2.	Ruopi	3.620 b	48.00 ab	5.880 a	2 b	1.509 a
3.	Indonesian	1.960 c	53.00 a	6.580 a	2 b	0.140 d
4.	Sir Lankan	5.500 a	45.00abc	7.280 a	2.4 ab	1.296bc
5.	Japanese	5.420	38.00 cd	6.720 a	2.6 ab	1.516 a
6.	Chuye	3.840 b	40.00 bcd	5.620 a	2.8 a	1.152 c
	LSD value	**0.7883**	**8.743**	**1.544**	**0.2799**	**1.469**

**Significant at 1% probability level; *Significant at 5% probability level
Note: Each value is a mean of five replications

Discussion

Different morphological characters of a plant are of pertinent significance when weighed in qualitative or/and quantitative fashion and subjected to authentic analysis. Leaves pose and leaf macro morphological features including leaf color have been widely used as diagnostic criteria in tea taxonomy. Thus tea was grouped into light leaved or dark leaved types on the basis of leaf color or high or low jats based on serration on leaf margin (Eden, 1976; Kaundun & Park, 2002; Luo *et al*., 2004).

Leaves characteristic are mostly used in selecting mother bushes for vegetative propagated clones, or as progenitors for breeding better seed plants with attributes for high yields. There is positive correlation between leaf size and yield (Mamedov, 1961; Devarumath *et al*., 2002; Mondal, 2002). The general belief that small leaved plants may yield less than large leaved plants are subjective because variation in size is also related to variation in leaf geometry and other related leaf characteristics (Banerjee, 1986, 1987, 1991). Length and density of hairs, and the distribution of calcium oxalate crystals are inherited quantitatively (Wight, 1958; Wu, 1964; Xue *et al*., 2006). The differences among the genotype mean for lamina length to breadth ratio is highly significant at 1% probability level. Sufficient genetic variability existed among the tea genotypes for lamina length. Lamina length for genotypes ranged from 8.10 to 11.70 cm representing difference of 3.60 cm. Maximum lamina length for the genotype Indonesian was recorded (11.70 cm), where as the lowest was observed (8.10 cm) for Qi Men. Qi Men, Ruopi, and Chuye genotypes did not express significant variability for lamina length. Our findings are supported by the previous work of Thai & Heiko (2004). They reported the same level of leaf length variation i.e. 5.9 to 13.3 cm. while the work of Banerjee (1987; Xue *et al*., 2006) is against our result i.e., 2.0 to 6.0 cm because he only selected third leaf but our data is for randomly five replications values for lamina breadth show that genetic variability existed among the genotype. Lamina breadth ranged from 3.32 to 5.69 cm with the net difference of 2.37 cm. The maximum lamina length was observed for Indonesian i.e., 5.69 cm followed by the Sri Lankan (4.29 cm) and Japanese (3.57 cm). Minimum lamina length was observed as 3.37 cm for Chuye followed by Ruopi (3.41 cm) and Qimen (3.51 cm). The present findings are congruent with work of Thai & Heiko (2004) but our report on tea morphogenetics is novel and first time reported from Pakistan. Results of this experiment are validly coincided with previous work of Jin *et al.* (2005; Zawko *et al*., 2001) that lamina breadth in *Camellia sinensis* L. varieties ranges from 3.2 to 6.4 cm. Lamina length to breadth ratio is dependent upon the lamina length and lamina breadth; so its correlation is paradigm of plants growth and yield with reference of its genotype and ecoclimatic conditions. Lamina length to breadth ratio for all genotypes ranged from 2.05 to 2.55 showing differences of 0.50. The minimum lamina length to breadth ratio was observed as 2.05 for Indonesian followed by observed for Ruopi (23.53 cm^2). This was significantly lower than all genotypes followed by Chuye (28.28 cm^2) and Qimen (28.65 cm^2). While maximum leaf area was observed as 66.91 cm^2 for Indonesian, which was statistically significantly higher than all genotypes. This was followed by Sir Lankan (41.49 cm^2) and Japanese (32.37 cm^2). Satyanarayana & Sharma (1986) and Banerjee (1987) studied leaf area of tea leaves having 120 mm^2 to 200 mm^2 but our findings are not in agreement with them, this may be due to small sample size or due to different climate of the area (Jin *et al.,* 2005; Lai *et al*., 2001). Like fresh leaves in tea, dry leaves are also important because formation of tea is totally dependent upon dry leaves and presence of chemical contents are directly related to weight of dry leaves. Mean values for dry leaf weight showed that genetic variability existed among genotypes. Dry leaf weight ranged from 0.12 to 0.44 g with net difference of 0.32 g. The maximum dry leaf weight was observed for Indonesian i.e. 0.44 g which was significantly higher than all genotypes followed by sir Lankan (0.24 g) and Japanese and Qimen showed statistically similar value (0.17 g). Whereas, minimum dry leaf weight was observed for Chuye which (0.122 g) was highly significant than all genotypes except Ruopi (0.126 g). In our findings, Indonesian has highest dry weight value which indicates that it has large amount of chemical content than to other genotypes (Mohanan & Sharma, 1981; Milligan *et al*., 1994).

Minimum Internode length was observed as 1.96 for Indonesian which was highly significant among all genotypes. This was followed by Chuye (3.84 cm), Qimen (3.74 cm) and Ruopi (3.62 cm) but these three were statistically similar. While the maximum mean value for inter node length was observed for Sri Lankan i.e. 5.50 cm which was statistically significant among all genotypes followed by Japanese (5.42 cm). Up to some extent the Hadfield (1974; Sha & Guo, 2005) study supports the present study i.e., 1.7 cm to 6.6 cm. Results of our study are highly supported by research work of Mohanan & Sharma (1981). Banerjee (1987) depicted that internode distances ranged from 15 mm to 65 mm and our findings also demonstrated 15 mm to 70 mm values. This demon was recommended by previous work of Satya Satyanarayana & Sharma (1986) and Hamid *et al*., 2006. Sufficient genetic variability existed among the tea genotypes for branch angle to stem. Branch angle to stem for genotypes ranged from 35 to 53 degree representing difference of 18 degree. Maximum branch angle to stem for the genotype Indonesian was recorded (53°), whereas the lowest was observed (35°) for Qimen. Our results are not in agreement with the previous study of Thai and Heiko (2004) i.e., 7.0 degree to 70.6 degree. As Tanton (1982; Wachira *et al*., 2001) pointed out, the seasonal differences in the length of shoot replacement cycle are sufficient to explain the variability in yield during the year at sites away from the equator. The level of shoot extension and underlying shoot population density is directly related to season variability depending on temperature, humidity and edaphic parameters. Sufficient genetic variability existed among the tea genotypes for shoot length (Table 3). Shoot length for genotypes ranged from 3.80 to 7.28 cm representing difference of 3.48 cm. Maximum shoot length for the genotype Sir Lankan was recorded (7.28 cm) among the genotypes whereas lowest shoot length was observed (3.80 cm) for Qimen. Our results are not in conformity of previous study of (Thai & Heiko, 2004; Wei *et al*., 2005) ***i.e.*** 5.6 cm to 13.2 cm. Jin ***et al.*** (2005) also studied same character according to them shoot length in *Camellia sinensis* L. genotypes were 5.8 cm to 8.2cm. Phenotypic variation in existing tea population was too wide to provide definite criteria for selection of better seed variation, even seed size is known to affect the growth of plant (Barua, 1961). Mean value for seed weight show that genetic variability existed among genotype. 10 seeds weight range from 1.51 to 0.14 g with net difference of 1.50 g. The maximum 10 seeds weight was observed for Japanese ***i.e***., 1.51g which was significantly except Ruopi (1.50 g) followed by Qimen (1.32 g) whereas, minimum 10 seeds weight among all genotypes were observed as 0.14 g for Indonesian which was highly significant lower than all genotypes. Current study is also supported by previous work of Jin ***et al.*** (2005) according to them seed weight in *Camellia sinensis* L. genotypes was 102 to 216 g.

For taxonomic analysis, quantitative characters were measured; data matrix was generated and subjected to analysis by Ward Method. As cluster analysis is very effective methods to classify germplasm on of traits homology (Nisar *et al.,* 2008). In present finding Wards method clearly sorted whole germplasm into two clusters, based on qualitative traits analysis. Cluster-1a indicates trait homology in between Japanese and Sir Lankan; their trait homology is in Leaf margin, leaf base and shoot's color (Wei *et al*., 2005). The genetic distance of their homology is 2 GD which is mirroring of the idea that these two genotypes are more relative in genetic make up. Cluster-1b indicates the trait homology in between Chuye and Ruopi; their trait homology is in leaf margin, leaf pose, leaf lower surface and shoot's color. The genetic distance of their homology is 1.7 GD that is depicting their genotypic and phenotypic similarity (Wight, 1958; Wei *et al*., 2005). While Cluster-II indicates trait homology in between Indonesian and Qimen their trait homology is in leaf shape, leaf margin, leaf lower surface, leaf upper surface, shoot color, leaf apices, and posture of leaf base. The genetic distance of their homology is 1.4 GD (Mamedov, 1961). Cluster-I ***i.e***., Cluster-1a and Cluster-1b are also show homology at genetic distance of 3 wards, while group I and group II also show homology and genetic distance of their homology is 4.5 GD (Mohanan & Sharma, 1981; Wei *et al*., 2005). These taximetrics findings regarding tea cultivars are congruently in line with the previous research work of Mong (Mong *et al.,* 2006). Hence, it proves that morphological features are not only of paramount significance in assessing tea yield but also they are key informative markers to identify and assign taxonomic status to certain species or varieties.

Conclusion

It is concluded form the present study that genotype Qimen has average value for desired quantitative characters, e. g. average vein pair, number of leaves at shoot, inter nodes distances and ideal branch angle to stem. This morphogenetic distinctiveness recommends that Qimen is well suited in the agro-climatic conditions of Pakistan for growth and production of tea as compared to other cultivars evaluated. Furthermore, taximetrics is excellent technique to find out name and type of any species or variety of tea plants or other plant species too.

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