Morphological Characterization of Tea Flower in Some Tea Genetic Resources

Aditi Smith and Subhash C Barua
Department of Tea Husbandry and Technology, Assam Agricultural University, Jorhat-785 013 (Assam)

The present investigation attempts to characterize 20 tea genetic resources which were growing in the Experimental Garden for Plantation Crops, Assam Agricultural University, Jorhat, on the basis of 10 flower characters. Three basic kinds of tea *viz.* China, Assam and intermediate Cambod types were considered as standards in the present study. Apart from using dimensional methods, morphological descriptor was used for characterization of floral morphology as per the recommendations of International Plant Genetic Resources Institute (IPGRI), Rome, Italy. The germplasm AS6, AS7, AS8, AS9, AS10, AS14, AS15 and AS16 resembled the Cambod type and exhibited better floral morphology, whereas AS1, AS2, AS4, AS11, AS12 and AS18 were similar to the Assam type and AS5, AS13, AS17, AS19 and AS20 were closer to the China type.

Key Words: *Camellia*, Descriptors, Germplasm, Morphological Characters, Taxonomy, Tea

Commercial tea plantations are extremely heterogeneous. They exhibit considerable variability in morphological characters due to natural hybridization over a prolonged period among the three principal tea producing taxa, *Camellia sinensis* (L.) O. Kuntze (China type), *C. assamica* (Masters) Wight (Assam type) and *C. assamica* ssp. *lasiocalyx* (Planchan ex. Watt.) Wight (Cambod type) and hybrids thereof or between them and other non-tea producing species of *Camellia* (Wight and Barua, 1957). The genetic diversity of tea plant is narrowing down due to massive uprooting of seed grown sections which were replanted with a few popular vegetative clones. Collection and conservation of genetic resources is gaining importance all over the world with the objectives of utilizing their genetic resources in the ongoing as well as future plant improvement work. In the process of collecting tea genetic resources for future improvement work, it is important to understand the genetic organization of the tea plant and the combination of genes in those hybrids which comprises the tea germplasm (Chen and Liao, 1987).

The floral morphology may be one of the best ways to understand the genetic combination of the tea plant and will help in the various improvement work for yield, quality and other desirable characters. Floral morphology provides a reliable diagnostic criteria for differentiating various taxa and their classification into discrete groups. Floral organs which have considerable importance are flower diameter, sepal number, corolla colour, petal number, filament length, anther length, stigma, stigma position, style and splitting of style. Unlike previous workers Wight (1962) relied mostly on the characteristics of style in differentiating between species and sub-species. Banerjee (1992) stated that the characteristics of taxonomical importance include variation in the number of styles and the degree of their fusion, disposition of stylar arm and globular or pubescent ovary. Banerjee (1992) further reported that Linnaeus recognized two species of tea, *Thea bohea* and *T. viridis* which were reported solely on the basis of number of petals, the former had six and the later nine.

Materials and Methods

Twenty different tea genetic resources (coded AS 1 to AS 20) growing in the Experimental Garden for Plantation Crops, Assam Agricultural University, Jorhat, were considered as the experimental material for studying floral morphology. Observations were made on 10 flower characters in peak flowering season *i.e.* December to January of the season, 2001-2002. For all the flower characters average of 10 flowers was taken. Flower diameter, sepal number, petal number, filament length and anther length were measured by using dimensional method. Corolla colour, stigma, stigma position, style and splitting of style were measured as per the recommendation of International Plant Genetic Resources Institute (IPGRI), Rome, Italy, descriptor and weightage used for numerical taxonomy are presented in Table 1. The three basic types of tea indigenous to the geographical region of South East Asia *viz.*, China, Assam and intermediate Cambod type were considered as standards in the present study.

Results and Discussion

Mean performance of the flower characters studied and weightage used for numerical taxonomy are presented in Table 2.

Table 1. Plant morphological descriptors of *Camellia* spp. used for diversity analysis for flower characters

Characters	Weightage
Flower diameter	Measured in cm
Sepal number	Measured in number
Corolla colour	1 White
	2 Cream
	3 White with red purple tinge
	4 Purple to purple violet
Petal number	Measured in numbers
Filament length	Measured in cm
Anther length	Measured in mm
Stigma l	Linear
	2 Apical
Stigma position	1 Extrose
	2 Introse
	3 Coplanar
Style l	Ascending
	2 Geniculate
	3 Terminal
Splitting of style	1 Geniculate (free for greater part of their length)
	2 Ascending (free for about half of their length)
	3 Terminal (united for greater part of the length)

The high flower diameter values was recorded in AS8 (5.5 cm), AS6 (5.4 cm), AS7 (5.4 cm) and AS15 (5.3 cm) while smallest flowers (3.3 cm) were observed in AS12 and AS13. The germplasm AS3 and AS12 had 2 sepals while most of the other germplasm had 5 sepals. Corolla colour was found to be white in all except AS11, AS15 and AS17 which exhibited white corolla with red purple tinge. In general, petal numbers were found to vary between 6 to 7 with an exception of 4 number of petals in germplasm AS7 and AS9. Filament length was found to be maximum (1.5 cm) in germplasm AS9 and AS 16 and the lowest was observed in AS13 (0.2 cm). The maximum anther length (2.1 cm) was found in AS6 and AS7. Table 2 also revealed that the germplasm AS1, AS2, AS11, AS16 and AS18 exhibited linear stigma whereas rest of the germplasm exhibited apical stigma. The germplasm AS5, AS9, AS10, AS11, AS12, AS13, AS17, AS19 and AS20 exhibited extrose type of stigma, AS1, AS3, AS4, AS14 and AS18 exhibited introse type of stigma and AS2, AS6, AS7, AS8, AS15 and AS16 exhibited coplanar stigma position. Geniculate type of splitting of style was found in germplasm AS3, AS5, AS13, AS19 and AS20, while germplasm AS6, AS7, AS8, AS9, AS15 and AS17 showed ascending type of splitting of style and germplasm. AS1, AS2, AS4, AS10, AS11, AS12, AS14, AS16 and AS18 had style having terminal splitting.

From the experimental findings it was observed that germplasm AS6, AS7, AS8, AS9, AS14, AS15 and AS16 have larger flower diameter, longer filament length and

Table 2. Mean performance of 10 flower characters and weightage on reproductive parts of flowers of different germplasm of tea on the basis of IPGRI descriptor

Germplasm	Flower diameter (cm)	No. of sepals	Corolla colour	No. of petals	Filament length (mm)	Anther length (mm)	Stigma	Stigma position	Style	Splitting of style
AS1	4.1	5	2	7	0.8	1.1	1	2	1	3
AS2	4.2	5	2	7	1.4	1.2	1	3	1	3
AS3	4.1	2	2	6	1.0	1.0	2	2	2	1
AS4	4.2	5	2	7	0.7	1.0	2	2	1	3
AS5	3.4	5	2	6	0.3	1.0	2	1	2	1
AS6	5.4	3	1	6	0.8	2.1	2	3	3	2
AS7	5.4	3	1	4	1.0	2.1	2	3	3	2
AS8	5.5	3	1	6	1.0	2.0	2	3	3	2
AS9	4.3	3	2	4	1.5	1.0	2	1	2	2
AS10	4.3	3	2	6	1.1	1.0	2	1	2	3
AS11	4.0	3	3	6	1.0	1.1	1	1	1	3
AS12	3.3	2	2	7	0.6	1.1	2	1	1	3
AS13	3.3	5	2	6	0.2	1.0	2	1	2	1
AS14	3.9	3	2	6	1.3	1.0	2	2	3	3
AS15	5.3	3	1	7	1.4	2.0	2	3	3	2
AS16	4.1	3	2	6	1.5	1.0	1	3	1	3
AS17	3.8	5	3	6	0.6	1.0	2	1	2	2
AS18	4.3	4	2	7	0.7	1.2	1	2	1	3
AS19	3.7	5	2	6	0.4	1.0	2	1	2	1
AS20	3.5	5	2	6	0.4	1.0	2	1	2	1
Assam	3.9	5	2	7	0.7	1.0	1	2	1	3
China	3.8	5	2	6	0.3	1.0	2	1	2	1
Cambod	6.0	3	1	6	1.0	2.0	2	3	3	2

Table 3. Comparison of tea germplasm with the three standard types for 10 flower characters

Germplasm	Flower diameter (cm)	No. of sepals	Corolla colour	No. of petals (mm)	Filament length (mm)	Anther length	Stigma	Stigma position	Style	Splitting of style	No. of characters resembling			Germplasm closer to standard
											Assam (A)	China (Ch)	Cambod (Ca)	
AS1	A/Ch	A/Ch	A/Ch	A	A	A/Ch	A	A	A	A	6	–	–	Assam
AS2	A/Ch	A/Ch	A/Ch	A	Ca	A/Ch	A	Ca	A	A	4	–	2	Assan
AS3	A/Ch	Ca	A/Ch	Ch/Ca	Ca	A/Ch	Ch/Ca	A	Ch	Ch	1	2	2	China/ Cambod
AS4	Ca	A/Ch	A/Ch	A	A	A/Ch	A/Ch	A	A	A	5	–	1	Assam
AS5	A/Ch	A/Ch	A/Ch	Ch/Ca	Ch	A/Ch	Ch/Ca	Ch	Ch	Ch	–	4	–	China
AS6	A/Ch	Ca	Ca	Ch/Ca	A	Ca	Ch/Ca	Ca	Ca	Ca	1	–	6	Cambod
AS7	Ca	Ca	Ca	–	Ca	Ca	Ch/Ca	Ca	Ca	Ca	–	–	8	Cambod
AS8	Ca	Ca	Ca	Ch/Ca	Ca	Ca	Ch/Ca	Ca	Ca	Ca	–	–	8	Cambod
AS9	Ca	Ca	A/Ch	–	Ca	A/Ch	Ch/Ca	Ch	Ch	Ca	–	2	4	Cambod
AS10	Ca	Ca	A/Ch	Ch/Ca	Ca	A/Ch	Ch/Ca	Ch	Ch	A	1	2	3	Cambod
AS11	A/Ch	Ca	–	Ch/Ca	Ca	A/Ch	A	Ch	A	A	3	1	2	Assam
AS12	A/Ch	Ca	A/Ch	A	A	A/Ch	Ch/Ca	Ch	A	A	4	1	1	Assam
AS13	A/Ch	A/Ch	A/Ch	Ch/Ca	Ch	A/Ch	Ch/Ca	Ch	Ch	Ch	–	4	–	China
AS14	Ca	Ca	A/Ch	Ch/Ca	Ca	A/Ch	Ch/Ca	A	Ca	A	2	–	4	Cambod
AS15	Ca	Ca	–	A	Ca	Ca	Ch/Ca	Ca	Ca	Ca	1	–	7	Cambod
AS16	Ca	Ca	A/Ch	Ch/Ca	Ca	A/Ch	A	Ca	A	A	3	–	4	Cambod
AS17	A/Ch	A/Ch	–	Ah/Ca	A	A/Ch	Ch/Ca	Ch	Ch	Ca	1	2	1	China
AS18	A/Ch	A/Ch	A/Ch	A	A	A/Ch	A	A	A	A	6	–	–	Assam
AS19	A/Ch	A/Ch	A/Ch	Ch/Ca	Ch	A/Ch	Ch/Ca	Ch	Ch	Ch	–	4	–	China
AS20	A/Ch	A/Ch	A/Ch	Ch/Ca	Ch	A/Ch	Ch/Ca	Ch	Ch	Ch	–	4	–	China

anther length. It was also found that the sampled germplasm can be grouped into three distinct groups on the basis of stigma position *i.e.* extrose type, introse type and coplanar type which is an important character for breeding work. The style of the flower is also important character which can be used for categorization of different tea species into three basic types of tea. The genetic materials were grouped into three groups– geniculate type, terminal type and ascending type on the basis of splitting of style which also helped to group the germpalsm into the three standard types.

For breeding work, plants with larger and improved reproductive organs are considered better which are exhibited by germplasm AS6, AS7, AS8, AS9, AS14, AS15 and AS16 compared to rest of the germplasm. Again when 20 germplasm are compared with the three standard types, it was observed that AS6, AS7, AS8, AS9, AS14, AS15 and AS16 were found to be similar with standard Cambod type, AS1, AS2, AS4, AS11, AS12, AS18 are found to be similar with standard Assam type and AS5, AS13, AS17, AS19, AS20 are found to be similar with standard China type (Table 3).

It can be concluded that the genetic resources nearer to Cambod type have larger flower structure compared to the two extreme types. Natural out-crossing among various species of *Camellia* might have resulted in better form of *Camellia* species with improved reproductive organs in the course of its evolution. Such germplasm, thus, be considered for further breeding programme and for future conservation.

Acknowledgement

The authors are grateful to Dr P Talukdar, Professor, Department of Plant Breeding and Genetics, Assam Agricultural University, Jorhat, Assam, for his constant encouragement, guidance and help extended in completing this work.

References

Banerjee B (1992) Botanical classification of tea. *In:* Wilson KS and MN Cliffor (eds) *Tea: Cultivation to Consumption.* Chapman & Hall, London, pp 25-51.

Chen A and H Liao (1987) *In vitro* study on the induction of haploid tea plants from anther. *Proc. International Tea Quality Human Health Symposium,* China, pp 4-10.

Wight W (1962) Tea classification revised. *Curr. Sci.* **33:** 298-299.

Wight W and PK Barua (1957) What is tea? *Nature* **179:** 506-507.