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Agro morphological characterization of cotton germplasm (*Gossypium hirsutum* L.)

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ABSTRACT : The present investigation was conducted to characterize 518 genotypes of cotton on the basis of 30 morphological characters as suggested by Protection of Plant Variety and Farmer's Right Act (PPV and FRA) for Distinctiveness Uniformity and Stability (DUS) testing in cotton. The experiment was conducted in the experimental area of the Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar in *kharif,* 2017-2018 in a randomized block design with three replications. Results revealed that there is no variation observed for gossypol glands, nectarines, petiole pigmentation, sepal pigmentation, petal spotting, boll bearing habit and boll colour. Moderate range of variation was recorded for hypocotyl pigmentation, plant stem pigmentation, plant stem hairiness, leaf shape, leaf appearance, bract type, stigma position, anther colour, boll surface and boll opening. The spacious scale of variation was observed for quantitative character like time of flowering, plant height, lobe number, number of serration and boll weight. Extensive extent of variation was observed for character like plant stem hairiness, leaf size, leaf colour, leaf pubescence, petal colour, anther colour, boll shape and boll tip these morphological characters proved to be useful and stable diagnostic characters which could classify the genotypes based on the phenotypic traits.

Key words: DUS, morphological characters, PPV and FRA, quantitative character

Gossypium is a large, rich and economically important genus. Cotton belongs to *Gossypium* genus and classified under the tribe *Hibisceae* in the family *Malvaceae*. It is the most important commercial crop of India and plays a major role in Indian economy. It occupies the place of pride in Indian agriculture by earning valuable foreign exchange. It is primarily used in textile industries providing highest employment during production, processing, spinning, weaving and marketing throughout the world. (Ranganatha *et al.,* 2013, Sangwan *et. al.,* 2018). Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsules, around the seeds of cotton plants. Descriptors of varieties of crop species are required for characterization of varietal identity, determine varietal purity and establish the distinctiveness of new variety from existing varieties and documentation of genetic resources. It means that the new variety has to be Distinct-Uniform-Stable (DUS) in its characteristics. Distinct means, a variety should be clearly distinguishable by one or more essential characteristics from any other existing variety. The variety is deemed uniform, if it is sufficiently uniform in its relevant characteristics, subject to variation that may be expected from the particular features of its population. The variety is said to be stable, if its relevant characteristics remain unchanged after repeated propagation.

Characterization of diverse genotypes for their morphological characteristics holds immense potential for their objective utilization in the breeding programme. Before breeding progremme is taken up it is desirable to elicit information on the extent of genetic variability present in the material. The assessment of extent of variation present in the genetic material becomes an essential step to know the magnitude of improvement that can be attained for various characters and to decide the ways to achieve it. To identify the desired genotypes for cotton improvement for seed cotton yield and its

attributing traits various researches have studied the morphological characters in cotton (Sangwan *et al.,* 2008; Ranjan *et al.,*2014; Shruti *et al.*, 2019; Reddy *et al.*, 2019). Therefore, the present investigation was carried to characterize the cotton germplasm for selected DUS-characters, yield and yield attributing traits.

The present investigation was carried to characterize 518 genotypes of cotton on the basis of 30 morphological characters provided by Protection of Plant Variety and Farmer's Right Act (PPV and FRA) for Distinctiveness Uniformity and Stability (DUS) testing in cotton. The field experiment was carried out during *kharif* 2017-2018 at experimental area of the Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The experimental design used was randomized block design with three replications. One row of each genotype was sown with row length of 3.0 m, row to row distance of 1.5 m, plant to plant distance of 30 cm. All the recommended package of practices were followed to raise a good crop. Five plants were randomly selected and tagged in each replication and their leaf, flower and boll characters were assessed based on visual observation.

Fourth leaf from the top of the plant was used for recording leaf characters such as leaf shape, leaf lobe number, leaf size, leaf colour, leaf pubescence, leaf appearance, leaf gossypol glands, leaf nectarines, leaf petiole pigmentation, Based on visual assessment shape of leaves was grouped as palmate/normal, semi digitate, digitate/okra, lanceolate/super okra. Leaf colour was classified as light green, green, light red and dark red while leaf hairiness was observed as sparse, medium and dense. The appearance was categorized as cup or flat shaped leaves and presence or absence of gossypol glands, leaf nectaries and leaf petiole pigmentation were also observed. Hairiness on stem was classified as smooth, sparse, medium and dense and the presence or absence of pigmentation on the stem was recorded at peak flowering stage. Hypocotyl pigmentation record as present and absent whereas the plant height is in replication.

Flower characters bract type, bract number of serration, sepal pigmentation, petal colour, petal spotting, filament colouration and anther colour were recorded including position of stigma,. The boll characters boll bearing habit, boll size, boll colour, boll shape, boll surface, prominence of boll tip, boll opening and the quantitative trait five boll weight were recorded. The boll bearing habit was observed as solitary or clustered. The trait boll shape was recorded before boll bursting and grouped into round, ovate and elliptic categories. Boll surface was classified into smooth and pitted surface and the tip of boll was observed and classified as blunt and pointed.

Researchers used morphological characters of plant, physical, physiological, biochemical, and molecular characterization of seed in crops like *Vicia faba*, sorghum, lucerne and cotton (Sagar *et al.* 2019 ; Balakrishnan, *et al.,* 2020) for identification of genotypes. Qualitative traits are considered as the most important characters to identify a particular plant variety. They are mostly genetically controlled thus least dependent on the environmental response. They form distinct phenotypic classes and therefore are useful tools in classifying germplasm and can be predominantly assessed visually. Because of these attributes large number of DUS (distinctiveness, uniformity and stability) characters for plant cultivar registration are defined using qualitative traits.

The observations on 25 qualitative traits were recorded for all the 518 genotypes and analysed as per scores presented in Table 1. Variation was found in 20 out of 25 qualitative traits. The traits namely gossypol glands, leaf nectarines, sepal pigmentation, boll bearing habit and boll colour were shown no variation between genotypes. Similar results were also observed by Sagar *et al.*, 2019 *i.e.* out of twenty

Table 1. Frequency distribution of qualitative traits recorded in *G. hirsutum* accessions of cotton germplasm

	Descriptors	States	Scores	Number of genotypes	Frequency (%)
1	Hypocotyl pigmentation	present	9	383	73.93
		absent	1	135	26.06
2	Plant stem pigmentation	present	9	383	73.93
		absent	1	135	26.06
3	Plant stem hairiness	strong	7	168	32.43
		sparse	3	109	21.04
		medium	5	241	46.5
4	Leaf shape	normal	1	457	88.22
		semi okra	2	61	11.77
5	leaf size	large	5	198	38.22
		medium	3	251	48.45
		small	1	69	13.32
6	leaf colour	green	2	356	68.72
		light green	1	162	31.27
7	Leaf pubescence	medium	5	379	73.16
		strong	9	139	26.83
8	Leaf appearance	cup	1	76	14.67
		flat	2	442	85.32
9	Leaf gossypol glands	present	9	518	100
		absent	1	0	0
10	Leaf nectarines	present	9	518	100
		absent	1	0	0
11	Petiole Pigmentation	present	9	515	99.42
		absent	1	3	0.5
12	Bract type	normal	3	510	98.4
		frego	5	8	1.54
13	Sepal pigmentation	absent	1	518	100
		present	9	0	0
14	Petal colour	cream	1	190	36.67
		purple	4	5	1
		yellow	3	323	62.35
15	Petal spotting	present	9	8	1.54
		absent	1	510	98.45
16	Position of stigma	embedded	3	91	17.56
		exserted	5	427	82.43
17	Filament colouration	present	9	5	0.96
		absent	1	513	99.03
18	Anther colour	cream	1	199	38.41
		purple	4	1	0.19
		yellow	2	318	61.38
19	Boll bearing habit	solitary,	1	518	100
		cluster	9	0	0
20	Boll size	large	5	118	22.77
		medium	3	321	61.9
		small	1	79	15.25
21	Boll colour	green	3	518	100
		red	5	0	0
22	Boll shape	round	3	151	29.15
		Ovate	5	288	55.59
		elliptic	7	79	15.25
23	Boll surface	smooth	1	405	78.18
		pitted	9	113	21.81
24	Boll tip	pointed	9	381	73.55
		blunt	1	137	26.44
25	Boll opening	close	2	12	2.31
		open	5	353	68.14
		semi open	3	153	29.53

morphological characters only nine characters *i.e.* leaf colour, leaf hairiness, leaf appearance, stem hairiness, flower petal colour, flower stigma, pollen colour, boll shape, boll tip showed significant variation and no variation is recorded for remaining eleven characters. Anjani *et al.*, 2018 also reported significant variations in eight descriptors *i.e.* leaf petiole pigmentation, stem petiole pigmentation, flower petal colour, stigma position, pollen colour, boll shape, boll surface and boll tip.

The character hypocotyl pigmentation showed no pigmentation in (26.06%) of accessions and the remaining (73.93%) were pigmented, whereas, plant steam pigmentation also showed the same frequency. For plant steam hairiness, medium present in 241 followed by dense 168 and sparsely present in 109 genotypes. In 457 accessions leaf shape was normal and remaining genotype expressed semi okra type. Higher frequency of medium leaf size was observed (48.45%) when compared with (38.22%, 13,32 %) of small and large leaf size respectively. Two class of leaf colour was observed namely green and semi green, maximum numbers of genotypes 356 were green. For leaf hairiness, medium present in 379 accessions followed by 139 strong. In 442 accessions leaf appearance was flat nature, whereas 76 expressed cup shape. Leaf nectarines and leaf gossypol gland were observed in all genotype. Pigmented leaf petiole was observed in 515 genotypes were absent in only 3 genotypes namely IC356790, IC356806 and IC356525. Normal bract was found in maximum accessions 510 and frego bract in rest of the accessions.

Expression of yellow petal colour was recorded in the higher number of accessions 323 followed by cream 130 and purple 5. The petal spotting were present in only 8 accessions namely IC 356701, IC356729, IC356816, IC356877, IC356833, IC356857, IC356881, and IC356882. Exerted states of flower stigma were recorded in 427 and embedded in 3 accessions. The states of expression of pollen colour were cream, yellow and purple. Maximum number of genotypes had yellow pollen colour (199) followed by cream (21) and only one purple. Absence of anther filament colouration was observed in all the genotypes except IC356540. Medium boll size recoded in maximum accessions 321 fallowed by large (118) and small (79). Ovate boll shape was found in 288 accessions followed by round (151) and elliptic (79). The smooth boll surface present in 405 accessions and 113 accessions had pitted surface. Regarding prominence of boll tip, 381 accessions had the blunt tip and 137 were pointed. The states of expression of boll opening were close, open and semi open in 12, 353 and in 153 accessions, respectively. Researchers had characterized the various cotton genotypes according to the DUS guidelines and observed significant variations among different elite genotypes of *G. hirusutum*. (Rai *et al.,* 2016; Anjani *et al.*, 2018; Sagar *et al.*, 2019; Balakrishnan *et al.*, 2020)

CONCLUSION

The variability present in the genetic material is a pre requisite for any crop improvement programme. The assessment of variation becomes an essential step to know the magnitude of improvement that can be attained for various characters and to decide the ways to achieve it. Hence, the characterization of genotypes using DUS descriptors is helpful for varietal identification and protection and studied genotypes are reservoirs for different parameters which can be exploited in breeding programmes. The present investigation is conducted for comparing the morphological characteristics of *G. hirsutum* accessions. A wide range of diversity for morphological traits was observed between various genotypes. Hence, this investigation is very useful in choosing the most precious accessions for further breeding programmes.

REFERENCE

Anjani, A., Padma, V., Ramana, J. V. and Satish, Y. 2018. Dus Characterization of Cotton (*Gossypium hirsutum L.*) *Int.J.Curr.Microbiol. App. Sci.,* **7** : 3900-04.

Balakrishnan, T., Vennila, S., Saravanan, K. R. and Karthikeyan, P. 2020. DUS characterization test of upland cotton (*gossypium hirsutum* l.) for quantitative characters. *Plant Arch.,* **20** : 3606-08.

Rai, P., Sangwan, O., Siwach, S. S., Sangwan, R. S., Pundir, S. R. and Nimbal, S. 2016. Morphological characterization of elite genotypes of upland cotton (*Gossypium hirsutum* L.). *J. Cotton Res. Dev.,* **30** : 36-40.

Ranganatha, H.M., Patil, S.S., Manjula, S.M. and Arvindkumar, B.N. 2013. Genetic variability studies in segregating generation of upland cotton (*G. hirsutum* L.). *Mol. Plant Breed.,* **4** : 84-88.

Ranjan, R., Sangwan, R.S., Siwach, S.S., Sangwan, O., Sah, M. and Singh, N. 2014. Studies on genetic divergence in *Gossypium arboreum* L. *J. Plant Breed. Genet.,* **2** : 57- 61.

Reddy, K.V.S., Balakrishna, B. and Reddy, C. V. 2019. Genetic Variability Studies for Quantitative and Qualitative Traits in Upland Cotton (*Gossypium hirsutum* L.). *Int. J. Pure App. Biosci.,* **7** : 350-53.

Sagar, Nimbal, S., Sangwan, R. S., Kumar, P., Jangid, K. and Reddy, B. 2019. DUS characterization of upland cotton (*Gossypium hirsutum* L.) elite genotypes by qualitative characters. *J. Pharmac. Phytochem.,* **8** : 1100-03.

Sangwan, O., Pundir, S.R., Khichar, M.L. and Singh, K. 2018. e_kapas advisory system using ICT for the cotton growers of Haryana. *J. Agromet.* **20** :193-98.

Sangwan, R.S., Siwach, S.S. and Ramesh Kumar. 2008. Evaluation of genetic stock of *desi* cotton (*Gossypium arboreum*). *J. Plant Genet. Resour.,* **21** : 68-71.

Shruti, Sowmya, H. C., Nidagundi, J.M., Lokesha, R., Arunkumar, B. and Murthy, S. M. 2019. Genetic variability studies for yield, yield attributing and fibre quality traits in cotton (*Gossypium hirsutum* L.). *Int. J. Curr. Microbiol. App. Sci.*, **8** : 2677-87

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