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Morphological characterization of elite genotypes of upland cotton (*Gossypium hirsutum* L.)

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ABSTRACT : The field studies were carried out to study the varietal characterization of various DUS characters of fifty elite lines of upland 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*, 2013-2014 in a randomized block design with three replications. On the basis of morphological characters provided by PPV and FRA for DUS testing in cotton information on morphological characters was generated. Results revealed that maximum variation among the morphological characters studied was present in hypocotyl pigmentation, leaf colour, leaf hairiness, leaf petiole pigmentation, leaf shape, leaf lobe number, leaf size, plant stem hairiness, plant stem pigmentation, plant height (cm), plant growth habit, bract type, bract number of serrations, days to 50 per cent flowering, flower petal colour, flower petal spot, flower stigma position, flower anther filament colouration, boll colour, boll shape (longitudinal section), boll surface, prominence of tip in boll, boll opening, number of locules/boll and seed fuzz density proved to be useful and stable diagnostic characters which could classify the genotypes based on the phenotypic traits.

Key words : DUS, morphological characters, upland cotton

Cotton is one of the most important commercial crops of India and plays a major role in Indian economy both in terms of providing raw material for textile manufacturing, mulch and cattle feed, employment directly and indirectly to about 60 million people and earning foreign exchange for the country. Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsules, around the seeds of cotton plants of the genus *Gossypium*, having 50 species among which 4 are cultivable *G. arboreum* L. and *G. herbaceum* L., the diploid (2n=26) species and *G. hirsutum* L. and *G. barbadense* L. are the tetraploid (2n=52) species with spinnable lint and rest are wild type with short seed fuzz.

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. In early days, all over the world, a small list of descriptors was sufficient to distinguish between crop varieties in use. However, in the recent decades, the world witnessed the emergence of large and highly competitive variety development programmes, particularly in the developed countries and also in some of the developing countries. Characterization of cultivars is required for their protection under PPV and FR Act 2001. Registration and protection can be granted to a variety only if it confirms to the criteria of Distinctness, Uniformity and Stability. It means that the new variety has to be Distinct Uniform Stable (DUS) in its characteristics. In India, certain diagnostic features are released for notified crop varieties and hybrids are used in seed certification. 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. Such descriptors can be used for characterization of elite breeding material to protect the piracy of the material thus, present study was undertaken to characterize the elite

lines on the basis of qualitative morphological characters.

The present investigation was carried out during *kharif* 2013-2014 in the Research Area of Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The experimental material for present study comprised of fifty elite lines of upland cotton. The seeds were collected from Cotton Section. Fifty elite lines *viz.*, Bro613, HS6, H1117, H1226, H1236, H1098-i, H1300, H1442, H1452, H1454, H1462, H1464, H1469, H1316, H1353, H1442-1, H1465, H1439, H1463, H1465, H1467, H1470, H1471, H1472, H1474, H1475, N11, BN, HS45, Deltapine, Texas377, RS921, B59-1679, GC182, F1638, IC357944, IC356543-A678, Tamcot CAMDE, CHYT15, Acala1517, Aubum, GTSV337, AR27, CSH1071, RS2098, CNH36, PIL8-5, AR40, PKV Rajat and OMS1were used for present study. The experimental design used was randomized block design with 3 replications with one row of each genotype of 3.0 m length. Row to row distance was 1.35 m with plant to plant distance 30 cm. Qualitative morphological characters listed by National DUS test guidelines descriptors for cotton were used for characterization.Hypocotyl pigmentation character was observed at seedling stage for presence and absence, leaf characters of 5 randomly selected and tagged plants in each line and replication were used to differentiate the elite lines of upland cottonunder study based on visual observations, fourth leaf from the top was selected for leaf characters such as leaf colour classified as light green,green and red under day light condition, while leaf hairiness was classified as medium and strong, whereas leaf petiole pigmentation was observed for presence and absence, leaf shape classified as palmate, digitate and lanceolate. Leaf lobe number prevalent in the material was classified as three and five. Leaf size in cotton genotypes was grouped as small, medium and large. Plant characters was observed after full vegetative growth is attained such as plant stem hairiness was recorded for medium and strong, while plant stem pigmentation was classified as presence and absence. Plant height (cm) was recorded as short, medium and tall, whereas plant growth habit at final picking stage was classified as spreading, semi spreading and compact. Flower characters found useful in varietal characterization were bract type classified as normal and frego, while bract number of serrations were classified as few, medium and many whereas days to 50 per cent flowering was recorded from the day of sowing to flowering in each replication classified as medium and late, flower petal colour categorized into cream yellow and pink, whereasflower petal spot was recorded for presence and absence. Flower stigma position was classified as embedded and exerted, while flower anther filament colouration was recorded for presence and absence of character. Boll characters useful in characterization were boll colour classified as green and red, boll shape (longitudinal section) was recorded before boll bursting as rounded, ovate and elliptic, while boll surface was recorded for smooth and pitted, prominence of tip in boll was classified as pointed and blunt. The character boll opening was recorded after opening of the boll and classified as semi open and open. The character number of locules/boll can be quite useful and classified as three, four and five locules per boll and seed fuzz density was classified as semi fuzzy and fuzzy depending upon the density of fuzz remains adhered to the seed after ginning.

The results obtained in the present investigation have been presented in the Table 1. Hypocotyl pigmentation was recorded as present or absent in the 50 cotton genotypes, 2 genotypes were grouped under absence and remaining 48 genotypes were grouped under presence of hypocotyl pigmentation. Similar classification was studied by Ponnuswamy *et al.*, (2003), Reddy *et al.,* (2007). Twenty five genotypes

studied were having light green leaves, 23 were having green leaves and 2 genotypes (BN, GC182) had red colour leaves (Reddy *et al.*, 2007). Hairiness on the leaves is very common cotton characteristic. Thirty four genotypes were having medium hairiness and remaining 16 genotypes were having strong hairiness (Reddy *et al.*, 2007; Aruna *et al.,* 2012) and realized the importance of hairiness on the leaves of cotton and also noticed that hairiness behaves like a simple mendelian trait giving 1:2:1 ratio in crosses between hairy and glabrous type of plants. Forty genotypes had leaf petiole pigmentation and remaining 10 genotypes were without leaf petiole pigmentation. Forty four genotypes under study leaf shape was palmate (normal), four genotypes (HS45, Texas377, RS921, BN) were having digitate (okra) and two genotypes (B59-1679, Deltapine) were of lanceolate (super okra) type, similar categorization was also studied by Reddy *et al.,* (2007) and Aruna *et al.,* (2012).

Hypocotyl pigmentation (HP) absent=1, present=9; Leaf colour (LC) light green=1, green=2, dark red=4; Leaf hairiness (LH) medium=5, strong=9; Leaf petiole pigmentation (LPP) absent=1, present=9; Leaf shape (LS) palmate (normal)=1, digitate (okra)=3, lanceolate (super okra)=4; Plant stem hairiness (PSH) medium=5, strong=7; Plant stem pigmentation (PSP) absent=1, present=9; Plant height (cm) (PH) small=3, medium tall (91-120)=5, tall (121-150)=7; Plant growth habit (PGH) compact (spreading<30 cm)=3, semi-spreading (31-60 cm)=5, spreading (>60cm)=7; Bract type (BT) normal=3, frego=5; Days to 50% flower (DFF) medium (50-60 days)=5, late (>60 days)=7; Flower petal colour (FPC) cream=1, yellow=2, purple=4; Flower petal spot (FPS) absent=1, present=9; Flower stigma position (FSP) embedded=3, exerted=5; Anther filament colouration (AFC) absent=1, present=9; Boll colour (BC) green=3, red=5; Boll shape (longitudinal section) (BSh) round=3, ovate=5, elliptic=7; Boll surface (BSf) smooth=1, pitted=9; Prominence of tip in boll (PTB) blunt =1, pointed=2; Boll opening (BO) semi-open=3, open=5; Number of locules per boll (NLB) three =1, four=2, five=3; Seed fuzz density (SFD) semi fuzzy=2, fuzzy=3; Bract no of serrations (BNS) few=3, medium =5, many =7; Leaf lobe number (LLN) three= 2, five=3; Leaf size (LS) small=3, medium=5, large=7.

Three genotypes (CSH1071, CNH36, PKV Rajat) had 3 leaf lobe number, while remaining forty seven genotypes with 5 leaf lobe number. The size of leaves in cotton genotypes was grouped as small, medium and large. Three genotypes had small leaf size, 26 genotypes with medium leaf size and 21 genotypes had large leaf size. Large leaf size is helpful to bring optimum plant growth with high dry matter accumulation (Reddy *et al.,* 2007). Nineteen genotypes were found to have medium stem hairiness and thirty one genotypes fall in strong hairiness category (Reddy *et al.*, 2007; Aruna *et al.*, 2012) and it is reported that stem hairiness is genetically controlled and vary from genotype to genotype (Webber, 1938). Twenty three genotypes had stem pigmentation and in remaining twenty seven genotypes plant stem pigmentation was absent (Aruna *et al.*, 2012). The plant height showed variation among genotypes. One genotype (IC357944) was short, 14 genotypes were medium and 35 genotypes were having tall plant height. Same classification was studied earlier by Reddy *et al.,* (2007) and Aruna *et al.,* (2012). The plant growth habit was spreading in 31 genotypes, semi-spreading type in 15 and compact type was found in 4 genotypes (IC357944, H1474, PIL8-5, Acala 1517). Cotton genotypes were grouped as normal and frego for the bract type, 49 genotypes were normal and remaining one genotype (OSM1) was having frego bract (Reddy *et al.*, 2007). The number of serrations on the bract is genetically controlled, 16 genotypes had few bract numbers of serrations, 32 genotypes with medium bract number of serrations and 2 genotypes (H1469, H1236) had many bract numbers of serrations. Similar type of categorization was done by Reddy

Tabke 1. Distribution of morphological characters in different elite lines of upland cotton

Characters Genotypes	HP	LC	LH	LPP	LS	PSH	PSP	PH	PGH	BT	DFF	FPC	FPS	FSP	AFC	BC	BSh	BSf	PTB	BO	NLB	SFD	BNS	LLN	LS
1. HS 6	1	2	5	1	1	5	1	5	7	3	7	1	1	5	1	3	5	1	2	5	2	2	5	3	7
2 H 1117	9	1	9	1	1	5	1	5	7	3	7	1	1	5	1	3	3	1	2	5	2	3	5	3	7
3. H 1226	9	2	5	9	1	7	1	7	7	3	7	2	1	5	1	3	5	1	2	5	2	3	5	3	7
4. H 1236	9	1	5	9	1	5	1	5	5	3	7	1	1	5	1	3	5	1	2	5	2	3	7	3	7
5. H 1098-i	9	1	9	9	1	7	9	5	7	3	5	1	1	5	1	3	5	1	2	5	2	3	3	3	7
6. H 1300	9	1	5	9	1	5	9	5	5	3	7	1	1	5	1	3	5	1	2	5	1	3	5	3	5
7. H 1442	9	1	5	9	1	7	9	7	5	3	7	1	1	5	1	3	3	1	2	5	2	3	3	3	7
8. H 1452	9	1	5	9	1	7	1	5	5	3	7	2	1	5	1	3	5	1	2	5	3	3	5	3	7
9. H 1454	9	1	5	9	1	7	9	7	5	3	5	1	1	5	1	3	5	1	2	5	2	3	5	3	7
10. H 1462	9	1	5	9	1	5	1	7	5	3	5	1	1	5	1	3	5	1	2	5	2	3	5	3	7
11. H 1464	9	2	9	9	1	7	1	5	5	3	7	1	1	5	1	3	3	1	2	5	2	3	5	3	7
12. H 1469	9	1	5	9	1	7	1	5	7	3	7	1	1	5	1	3	5	1	2	5	1	3	7	3	5
13. H 1316	9	1	5	9	1	7	1	5	5	3	7	2	1	5	1	3	3	1	2	5	1	3	3	3	5
14. H 1353	9	2	5	1	1	7	1	5	7	3	5	2	1	5	1	3	5	1	2	5	2	3	3	3	7
15.H14421	9	1	5	9	1	7	1	5	5	3	5	1	1	5	1	3	5	1	2	5	3	3	3	3	5
16. H 1465	9	1	5	9	1	5	9	7	7	3	5	1	1	5	1	3	5	1	2	5	1	3	5	3	5
17. H 1439	9	2	9	1	1	5	1	5	7	3	7	1	1	5	1	3	5	1	2	5	2	3	5	3	5
18. H 1463	9	1	9	1	1	7	1	5	7	3	7	2	1	5	1	3	5	1	2	5	1	3	5	3	5
19. H 1465	9	1	5	1	1	7	1	7	7	3	5	1	1	5	1	3	3	1	2	5	2	3	5	3	5
20. H 1467	9	2	9	9	1	5	9	7	7	3	5	1	1	5	1	3	5	1	2	5	3	2	5	3	7
21. H 1470	9	2	5	9	1	7	1	5	7	3	5	2	1	5	1	3	5	1	2	5	2	3	3	3	5
22. H 1471	9	2	9	1	1	7	1	5	7	3	7	2	1	5	1	3	5	1	2	5	1	3	3	3	7
23. H 1472	9	2	5	9	1	5	9	5	7	3	5	2	1	5	1	3	5	1	2	3	2	3	5	3	7
24. H 1474	9	2	5	1	1	7	1	5	3	3	5	2	1	5	1	3	5	1	2	5	2	3	5	3	5
25. H 1475	9	2	9	9	1	7	9	7	5	3	5	1	1	5	1	3	5	1	2	5	1	3	5	3	5
26. N11	9	4	5	9	1	5	9	7	7	3	5	4	1	5	1	5	5	1	2	5	2	2	5	3	5
27. BN	9	2	5	9	3	5	1	5	7	3	7	1	1	5	1	3	5	1	2	5	1	3	5	3	5
28. HS45	9	2	5	9	3	7	9	7	7	3	7	1	1	5	1	3	3	1	2	5	3	2	5	3	5
29.Deltapine	9	2	5	9	4	7	1	5	7	3	7	1	1	5	1	3	5	1	2	5	1	3	3	3	3
30.Texas377	9	2	5	1	3	7	1	5	7	3	5	1	1	5	1	3	3	1	2	5	3	3	5	3	7
31. RS921	9	1	9	9	3	5	1	7	7	3	7	1	1	5	1	3	3	1	2	5	2	3	5	3	7
32.B591679	9	2	9	9	4	5	1	7	7	3	5	2	1	5	1	3	3	1	2	5	1	3	5	3	7
33. GC182	9	4	5	9	1	5	9	5	5	3	5	4	1	5	1	5	3	1	2	5	2	3	5	3	7
34. F1638	9	1	5	9	1	7	9	5	5	3	5	1	1	5	1	3	3	1	1	5	2	3	5	3	5
35. Bro6 13	9	1	9	9	1	7	1	5	7	3	7	2	9	5	9	3	5	1	2	5	2	3	5	3	5
36. OMS1	9	2	5	9	1	5	9	5	7	5	7	1	1	5	1	3	5	1	2	5	1	3	5	3	7
37.IC357944	9	1	5	9	1	5	9	3	3	3	7	1	9	5	1	3	3	1	2	5	2	3	5	3	5
38.IC356543-A6789	1	5	9	1	5	9	5	7	3	7	2	9	5	1	3	3	1	2	5	2	3	5	3	5
39. TamcotCAMDE	9	2	5	9	1	5	1	5	7	3	7	1	1	5	1	3	5	1	2	5	2	3	5	3	3
40. CHYT 15	9	2	9	9	1	5	9	5	7	3	7	2	1	5	1	3	3	1	2	5	2	3	5	3	3
41.Acala1517	9	2	5	9	1	7	9	5	3	3	7	1	1	3	1	3	3	1	1	3	1	3	3	3	5
42. Aubum	9	2	9	9	1	7	9	7	7	3	7	1	1	5	1	3	3	1	2	5	1	3	3	3	7
43.GTSV337	9	1	9	9	1	7	9	5	7	3	7	1	1	5	1	3	3	1	1	5	2	3	3	3	5
44. AR27	9	2	5	9	1	7	1	7	5	3	7	2	1	5	1	3	3	1	2	5	2	3	5	3	5
45. CSH1071	1	2	5	9	1	7	1	5	7	3	7	2	1	5	1	3	5	1	2	5	1	3	3	2	5
46. RS2098	9	1	5	9	1	7	1	5	5	3	5	1	1	5	1	3	5	1	2	5	3	3	3	3	5
47. CNH36	9	1	9	9	1	7	9	5	5	3	5	2	1	5	1	3	5	9	2	5	2	3	3	2	5
48. PIL8-5	9	1	5	9	1	7	9	5	3	3	7	1	1	5	1	3	7	1	2	5	2	3	3	3	5
49. AR40	9	1	5	9	1	7	9	5	7	3	7	1	1	5	1	3	7	1	2	5	2	3	3	3	5
50.PKV Rajat	9	1	9	9	1	7	9	5	7	3	7	2	1	3	1	3	5	1	2	5	2	3	5	2	7

et al., (2007) in cotton.On the basis of days to 50 per cent flowering, genotypes were grouped as early, medium and late duration. Nineteen genotypes were in medium category (50-60 days) while thirty one genotypes were classified under late (>60 days), similar reports by Reddy *et al.,* (2007) and Aruna *et al.,* (2012). Reasons attributed for differences in days to 50 per cent flowering among the genotypes is due to genotypic effect and least influenced by environment but the studies on nature of gene governing days to 50 per cent flowering are meager and dominance gene action for days to 50 per cent flowering was reported. Flower petal colour is one of the important character for characterization and was classified as cream, yellow and pink. Thirty one genotypes had cream petal colour, seventeen with yellow and two genotypes (GC182, N11) had pink petal colour (Reddy *et al.,* 2007). The petal spot is used as the marker for varietal identification (Ahuja *et al.,* 2009) and based on petal spot grouping is done as present or absent. Three genotypes (Bro613, IC356543-A678 and IC357944) found to have flower petal spot while 47 genotypes showed absence of petal spot. Variation in petal spot is due to genetic effect and it is due to polygenes which has cumulative effect and usually dominant genes are observed (Reddy *et al.,* 2007; Aruna *et al.,* 2012). Flower stigma position was exerted in 48 genotypes and 2 genotypes (PKV Rajat, Acala1517) had embedded stigma (Reddy *et al.,* 2007). In majority of genotypes (49) anther filament colouration was absent while present in only 1 genotype (Bro613). Majority of the genotypes (30) had cream pollen colour and rest (20) had yellow pollen colour. Boll colour in majority of the genotypes (48) was green and in 2 genotypes (N11, GC182) was red in colour. Boll shape (longitudinal section) categorized as round, ovate and elliptic, eighteen genotypes had rounded boll shape, 30 genotypes with ovate boll shape and two genotypes (PIL8-5, AR40) had elliptic boll shape (Reddy *et al.,* 2007; Aruna *et al.,* 2012). Majority of the genotypes (49) had smooth boll surface and one genotype (CNH36) had pitted boll surface. Forty seven genotypes had pointed boll tip and rest 3 genotypes (GTSV337, Acala517, F1638) had blunt boll tip. Forty eight genotypes had open type of boll opening and remaining 2 genotypes (H1472, Acala 1517) were in semi-open category. Number of locules/boll, fourteen genotypes had 3 number of locules/boll, 30 genotypes with 4 locules/boll and 6 genotypes have 5 locules/boll. For the trait seeds/locule, 3 genotypes had low seeds/locule (H1316, GTSV337, Tamcot CAMDE) and 27 genotypes with medium seeds/locule and 20 genotypes have high seeds/locule. The quantum of the fuzzy nature of the seed was used as criteria to distinguish the cotton genotypes and the genotypes were categorized as fuzzy and non fuzzy. Four genotypes (HS6, H1467, N11, HS45) had seed fuzz density semi-fuzzy, 46 genotypes with fuzzy seed fuzz density (Reddy *et al.,* 2007).

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