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Morphological characterization of *Bt* cotton hybrids

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ABSTRACT : Characterization and identification of genotypes is essential for their release, notification and seed production. Practically, a genotype must show distinct, uniform and stable characteristics that can be adopted for use in characterization and identification. The present study was undertaken for phenotypic characterization of most popular *Bt* cotton hybrids recommended for Haryana. The experimental material for the present investigation comprised of 28 *Bt* cotton hybrids of different companies, one non *Bt* check hybrid (HHH 223) with its parental lines and one non *Bt* check variety (H 1226). Experimental material was sown in the Research Area, Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. Morphological characters namely flower petal colour, pollen colour, boll shape, leaf hairiness, plant growth habit, tip of the boll and position of stigma proved to be useful and stable as diagnostic traits to classify the genotypes based on the phenotypic traits.

Key words : *Bt* cotton, *Gossypium hirsutum,* morphological characters

Cotton is the most important commercial crop of the world known as “King of Fibres”. Cotton is valued for its fibre and seed is used as a source of feed for animals and oil for human consumption. Among the various cotton growing countries of the world, India is the only country where all the four cultivated species of cotton *viz., Gossypium arboreum* L., *G. herbaceum* L., *G. hirsutum* L., and *G. barbadense* L. and their hybrids are commercially grown. India has the largest area under cotton (118 lakh ha) accounting for about 39 per cent of world cotton acreage, and ranks first in cotton production (338 lakh bales of 170 kg each). In Haryana cotton is grown in an area of 6.03 lakh ha with production of 15 lakh bales and productivity of 423 kg/ha.

Characterization of genotypes is essential for their identification and some time to rule out or confirm the purity of the hybrid, as the seed of *Bt* cotton hybrid is very costly. Many a time the field functionaries have to face the problem of mixture of *Bt* cotton hybrid seed. Keeping these problems in mind this experiment was conducted to distinguish different promising *Bt* cotton hybrids on morphological characters. Practically, a genotype must show distinct, uniform and stable characteristics that can be adopted for use in characterization and identification. For using morphological characters, replicated measurements are taken in order to specify the minimum genetic distance.

The experimental material for the present investigation comprised of 28 most popular *Bt* cotton hybrids of different seed companies recommended for north India, one non *Bt* check hybrid (HHH 223) with its parental lines and one check variety (H 1226). All the experimental material hybrids, checks were sown in the Research Area, Department of Genetics and Plant Breeding, CCS Haryana

Agricultural University, Hisar during *kharif,* 2010-2011. The *Bt* cotton hybrids used in the present study were MRC 6304 *Bt*, MRC 6025 *Bt*, Ankur Jai *Bt*, Cot 33 *Bt*, Mist BG II, Namcot 617 BG II, ABCH 1165 *Bt*, ABCH 1020 BG II, JKCH 1947 *Bt*, JKCH 1050 *Bt*, Bioseed 6588 BG II, Bioseed 6488 *Bt*, Bioseed 6488 BG II, VICH 307 BG II, VICH 308 BG II, VICH 309 BG II, VICH 310 BG II, SP 7010 BG II, SP 7007 BG II, IT 905 *Bt*, NCS 904 *Bt*, NCS 858 BG II, NCS 902 *Bt*, NCS 855 BG II, Tulasi 4 BG II, Tulasi 162 BG II, RCH 134 *Bt* and RCH 134 BG II. The experimental material was planted in randomized block design with three replications. There were four rows of six meter length of each hybrid with a spacing of 100 x 60 cm. All the recommended package of practices were followed to raise a good crop. Five competitive plants were taken randomly from each genotype in each replication for recording of data on the following characters as per the guidelines for the conduct of test for the DUS (distinctiveness, uniformity and stability) on tetraploid cotton by the protection of plant variety and farmers' rights authority (PPV and FRA) Govt. of India. The characters under study comprised of hypocotyl pigmentation (present or absent), leaf colour (light green, green and dark green), leaf hairiness (sparse, medium and dense), leaf appearance (cup shaped or flat), leaf gossypol glands (present or absent), leaf nectaries (present or absent), leaf petiole pigmentation (present or absent), leaf shape [palmate (normal), semi digitate (semi okra), digitate and lanceolate (super okra)], stem hairiness (smooth, sparse, medium and dense), stem pigmentation (present or absent), plant growth habit (compact, semi spreading and spreading type), bract type (normal, large and frego), flower petal colour (cream, yellow and deep yellow), flower petal spot (present or absent), flower stigma (embedded and exerted), flower anther filament (present or absent), flower pollen colour (white, cream and yellow), boll bearing habit (solitary and cluster), boll colour (green or red), boll shape (round, ovate and elliptic), boll surface (smooth or pitted), prominence of tip in boll (blunt or pointed), boll opening (semi open or open), seed fuzz (naked, sparse, medium and dense) and seed fuzz colour (white, grey, green and brown).

The experimental material was characterized on the basis of morphological traits recorded in the field at different stages of plant growth. Hypocotyl pigmentation was absent in all the genotypes. On the basis of leaf colour there were three classifications as light green, green and dark green but all the genotypes studied were having dark green leaves. Leaf hairiness was medium for all the genotypes except for ABCH 1020 BG II and JKCH 1947 *Bt* for which leaf hairiness was sparse. For the leaf appearance there were two classes, cup shaped or flat, for all the genotypes studied exhibited flat leaf appearance. These genotypes were studied for the presence or absence of gossypol glands on leaf, which were present on all the genotypes under study. Similarly, the presence or absence of nectaries was observed which were present in all the genotypes. On the basis of leaf shape there were three categories palmate (normal), digitate (semi okra) and lanceolate (okra), but all genotypes under study showed the palmate (normal) leaf shape. The genotypes under study were observed for the presence or absence of leaf petiole pigmentation, stem hairiness and plant stem pigmentation, but for all the genotypes studied, these characters were absent. The genotypes were classified as compact, semi

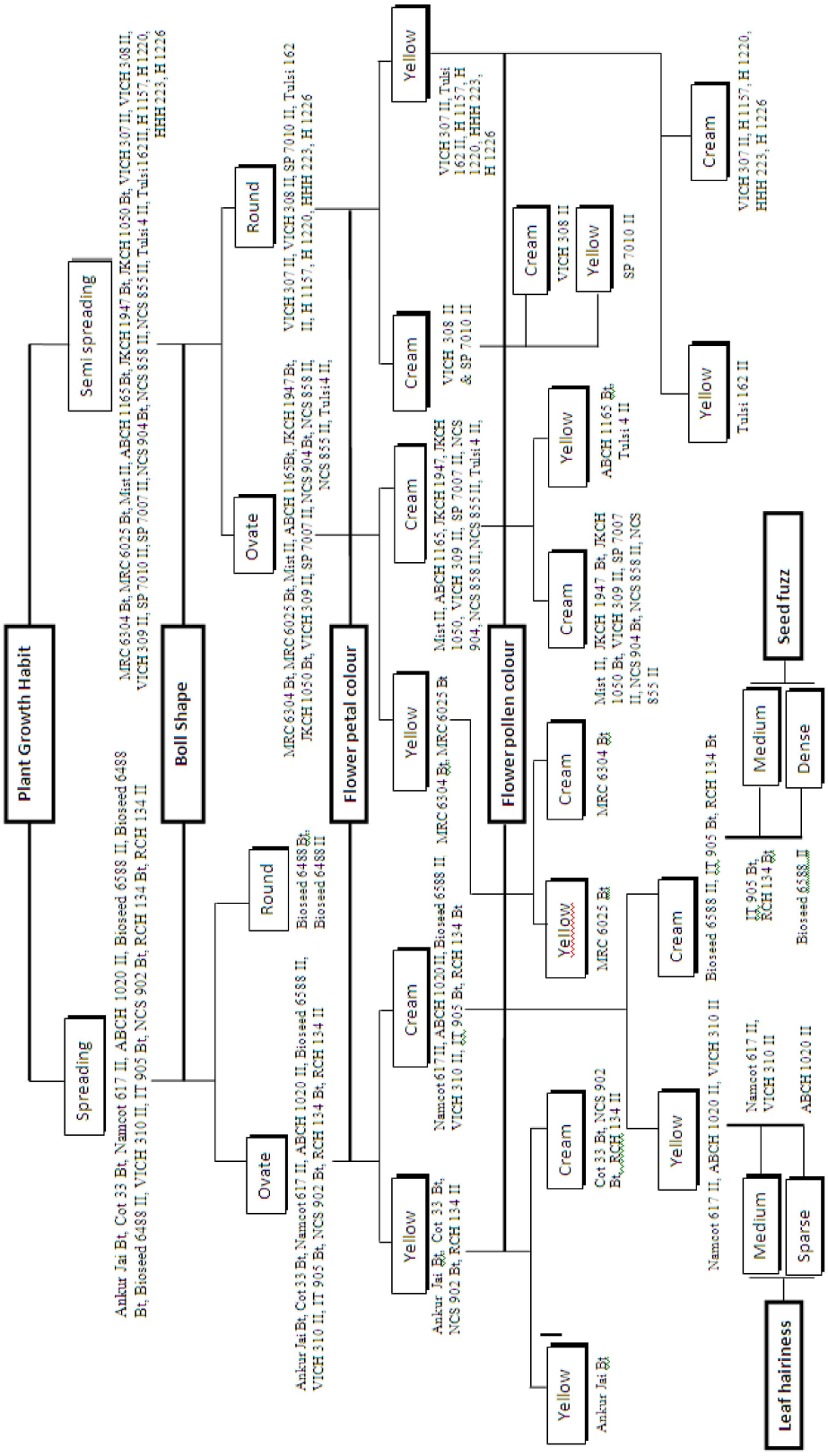

Fig. 1. Schematic diagram based on morphological traits for characterization of cotton

spreading and spreading based on plant growth habit which was semi-spreading in general, except for Ankur Jai *Bt*, Cot 33 *Bt*, Namcot 617 BG II, ABCH 1020 BG II, Bioseed 6588 BG II, Bioseed 6488 *Bt*, Bioseed 6488 BG II, VICH 310 BG II, IT 905 *Bt*, NCS 902 *Bt*, RCH 134 *Bt* and RCH 134 BG II where the plant growth habit was spreading type (Reddy *et al.,* 2007; Aruna *et al.,* 2012). For the bract type, there were three classes normal, large and frego bracts. All the genotypes exhibited normal bract type. Two types of petal colour *i.e.* cream and yellow were present in all the 32 genotypes. Among them 20 had cream petal and 12 had yellow flower petal colour. The genotypes exhibiting yellow coloured petals were MRC 6304 *Bt*, MRC 6025 *Bt*, Ankur Jai *Bt*, Cot 33 *Bt*, VICH 307 BG II, NCS 902 *Bt*, Tulasi 162 BG II, RCH 134 BG II, H1157, H1220, HHH223 and H1226 while the genotypes Mist BG II, Namcot 617 BG II, ABCH 1165 *Bt*, ABCH 1020 BG II, JKCH 1947 *Bt*, JKCH 1050, Bioseed 6588 BG II, Bioseed 6488 *Bt*, Bioseed 6488 BG II, VICH 308 BG II, VICH 309 BG II, VICH 310 BG II, SP 7010 BG II, SP 7007 BG II, IT 905 *Bt*, NCS 904 *Bt*, NCS 858 BG II, NCS 855 BG II, Tulasi 4 BG II and RCH 134 *Bt*, had cream petal colour. The presence or absence of the petal spot was observed which was absent in all the genotypes. On the basis of stigma position in flower the genotypes were classified as embedded or exerted. The stigma was exerted in all the genotypes except for H1157 (female parent of HHH 223) where it was embedded. The anther filament colouration was absent in all genotypes. In all genotypes studied only two type of pollen colour was observed *i.e.* cream and yellow. Majority of the genotypes (23) had cream pollen colour and rest (9) had yellow pollen colour viz. MRC 6025 *Bt*, Ankur Jai *Bt*, Namcot 617 BG II, ABCH 1165 *Bt*, ABCH 1020 BG II, VICH 310 BG II, SP 7010 BG II, Tulasi 4 BG II and Tulasi 162 BG II. For all the genotypes studied boll bearing habit was solitary while the boll colour was green and boll surface was smooth in all the genotypes. Two types of boll shapes were observed among the different genotypes *i.e.* ovate and round. The shape of the boll was ovate in 22 genotypes, while in rest of ten genotypes namely Bioseed 6488 *Bt*, Bioseed 6488 BG II, VICH 307 BG II, VICH 308 BG II, SP 7010 BG II, Tulasi 162 BG II, H 1157, H 1220, HHH 223 and H 1226, it was round. All the genotypes showed pointed tip of boll except VICH 308 BG II which was blunt. On the basis of boll opening there were two categories semi open and open, however the bolls were opened in all the genotypes. All the genotypes showed medium fuzz on the seed except on Bioseed 6588 BG II which was having dense seed fuzz and its colour was white in all the genotypes studied.

The morphological observations were recorded on all the experimental material for their distinctness. Among the characters studied flower petal colour, pollen colour, boll shape, leaf hairiness, plant growth habit, tip of the boll and position of stigma proved to be useful and stable diagnostic characters which could classify the genotypes into different groups. Whereas the traits like hypocotyl pigmentation, leaf colour, leaf appearance, leaf gossypol glands, leaf nectaries, leaf petiole pigmentation, leaf shape, plant stem hairiness, plant stem pigmentation, bract type, flower petal spot, flower anther filament colouration, boll bearing habit, boll colour, boll surface, boll opening and seed fuzz colour showed similarity for the genotypes indicating that these traits may be ignored for identification of these genotypes. The flower petal colour classified the genotypes into two categories *i.e.* cream and yellow petal colour, similarly for the flower pollen colour there were two classes cream and

yellow pollen colour (Reddy *et al.,* 2007). For the leaf hairiness genotypes were classified as medium and sparse hairiness, while the plant growth habit classified the genotypes in two categories spreading and semi spreading. According to tip of boll the genotypes were classified as pointed or blunt tip. For the position of stigma there were two classes as embedded or exerted stigma (Reddy *et al.,* 2007), So these characters may be considered for identification of these genotypes.

In cotton, large number of new hybrids had been released in the market in quick succession and it was very difficult to distinguish each and every hybrid in the absence of defined characters and it was a challenging task to distinguish the released hybrids. So there was a need to develop key characters for identification of genotypes. Hence a flow chart was prepared using qualitative characters to find out distinctive features of some of the genotypes (Fig. 1). Considering plant growth habit as the primary character, all the genotypes were grouped under two categories spreading and semi spreading, which were further classified based on boll shape into two groups each of ovate and round. Further classification was based on flower petal colour and then flower pollen colour which could separate out Ankur Jai *Bt*, MRC 6025 *Bt*, MRC 6304 *Bt*, Tulsi 162 II, VICH 308 II and SP 7010 II. Seed fuzz and leaf hairiness could further separate out ABCH 1020 II and Bioseed 6588 II. So the path could be key diagnostic feature for characterization of genotypes. Similarly, Singh (1995) and Ramanadham (2000) also prepared flow chart for identifying genotype on the basis of various key morphological characters recorded, while Patil and Suryawanshi (1996) prepared bulletin for diagnostic morphological characteristics of cotton.

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