Characterization of Cotton Germplasm using IBPGR Descriptors

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ABSTRACT

One of the problems in germplasm collection is uncharcterization for common germplasm descriptors. A systematic study was conducted to characterize the sixty cotton germplasm lines using IBPGR descriptors at Agricultural College, Bapatla, India. The data was collected on days to 50 per cent flowering, stem, leaf, flower, boll and quality parameters. Variability was observed for twenty two parameters out of twenty nine descriptors studied. The descriptors are helpful in breeding for multiple disease resistant cultivars and improving the fiber quality characteristics.

Key words : Characterization, Cotton, Descriptors, IBPGR.

Systematic effort was made to characterize the cotton germplasm by using International Board of Plant Genetic Resources (IBPGR) descriptors of cotton to document the data for easy identification and also to avoid the duplication and unnecessary evaluations of repetitive accessions in the collection and for locating useful genes from the germplasm accessions. This ultimately aims at development of desirable cotton varieties for commercial cultivation by farmers.

MATERIAL AND METHODS

The main objective of the investigation was to characterize the cotton germplasm to assess their potential to contribute to future crop improvement programmes. The sixty cotton germplasm lines with diverse origin were evaluated during *Kharif* 2007 at Agricultural College Farm, Bapatla, Andhra Pradesh, in randomised block design in three reptcations at inter and intra row spacing of 120 x 60 cm.

The study was divided into four parts *i.e*., the first data collection was taken on days to 50% flowering; second on stem, leaf and flower characteristics during peak flowering stage; third during peak boll development and the fourth on quality parameters of the cotton fiber after harvest.

Data was collected by selecting randomly five plants per genotype per replication and were used for the differentiation of the germplasm lines based on IBPGR descriptors. The descriptors recorded for the present investigation were days to 50% flowering, stem pigmentation, stem hairiness, leaf shape, leaf lobe number, leaf size, leaf colour, leaf pubescence, leaf appearance, leaf gossypol glands, leaf nectaries, leaf petiole pigmentation, bract shape, bract number of serration, flower sepal pigmentation, petal colour, petal spotting, position of stigma, filament colouration, anther colour, boll bearing habit, boll size, boll colour, boll shape, boll surface, boll prominence at tip, boll opening, plant habit, plant height, fiber length, fiber strength, fiber fineness and fiber uniformity.

RESULTS AND DISCUSSION

The frequency and descriptor values of the sixty cotton germplasm lines are summarized in Table 1. No plant among the germplasm lines evaluated showed a deviation to characteristic from the mentioned descriptors in Table 2. Xavier Zumba (2004) also studied the Shafter cotton collection of USA for the descriptors and reported the value of the lines in the breeding programmes.

Stem pigmentation was observed in only one line (Tx Lama). Stem hairiness was sparse in 16 lines and medium in 44 lines. A hairy stemmed plant is common cotton plant characteristic and most cotton breeders would rather prefer smooth plants in their breeding programmes as absence for hairiness reduces the egg laying as much as 50% by making the plant unattractive as an oviposition site for the bollworm (Ledge *et al.,* 1992).

Among the leaf characteristics, variation was observed for leaf colour, leaf pubescence, leaf lobes and leaf shape. No variation was observed for leaf size (Large type), leaf appearance (Flat), leaf gossypol glands and leaf nectaries. Large leaf size is helpful to bring optimum plant growth with high

Table 1. Frequency of cotton genotypes for different morphological and quality parameters

Score	50% D	SP	SH	LS	LL	LC	LP	PP	SP	PC	Pspot	Stigma P	FC	AC	BS	BC	B shape	BT	pH	FL	FS	FF	FU
1	59	59		58				59	59		58	13	59			59	14	4				1	
2										49		47	1	34		1	39	56				17	1
3			16	1	32	59				10				25	3		7		50	48	8		
4				1	28	1								1									
5			44				53								57				10	46	52	39	3
6										1													
7			3																	16		3	56
8																							
9		1					7	1	1		2												

50% D : Days to 50% Flowering (3 = < 45%- early, 5 = 45-60-medium, 7= > 60-late); StP : Stem Pigmentation (1= absent, 9=present); SH: Stem Hairiness (3= sparse ; 5= medium); LS: Leaf Shape (1 = palmate; 3 = okra): LL : Leaf Lobes (2 = three; 3= five); LC : Leaf Colour (2 = green, 4= dark red); LP : Leaf Pubescence (5 = medium; 9= strong); PP: Petiole Pigmentation (1 = absent, 9= present) SP: Sepal Pigmentation (1= absent, 9 = present); PC: Petal Colour (2= cream, 3= yellow, 6 = brown) Pspot – Petal Spot (1 = absent, 9 = present), Stigma P = Sigma Position (1 = embedded; 2 = exserted); FC : Filament Colour (1 = absent, 2 = red); AC : Anther Colour (2 = cream, 3 = yellow, 4= purple); BS : Boll Size (3= small, 5= medium); BC : Boll Colour (1 = green, 2 = red); Bshape : Boll Shape (1 = round, 2 = ovate; 3 = elliptic); BT = Boll Tip (1= blunt;2= pointed); PH = Plant Height (3 = short-61-90 cm, 5 = medium, 91-120 cm) FL = Fiber Length (1 = very short- <20mm, 3 = short 20.5 – 24.5mm, 5 = medium 25-29mm, 7 = long 29.5-33.5mm 9- extra long > 33.5mm); FS = Fiber Strength (3 = weak-<20 gtex, 5 = medium 21.1-25.0 gtex, 7 = strong >25.0 gtex); FF= Fiber Fineness1 = very fine <3, 3 = fine-3-3.9, 5 = medium 4-4.9, 7= coarse 5-5.9, 9= very coarse >5.9); FU=Fiber Uniformity (3 = poor-<40, 5 = average- 42-45 , 7 = good- >45).

Table 2. IBPGR descriptors for different morphological and quality parameters in sixty cotton germplasm lines

Genotype	50% D	StP	SH	LS	LL	LC	LP	PP	SP	PC	P- spot	Stigma -P	FC	AC	BS	BC	B- shape	BT	FL	FS	FF	FU
Dunn118	59	1	3	1	3	2	5	1	1	2	1	2	1	2	5	1	1	2	5	3	5	7
ARB815	50	1	3	1	3	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
TSH333	51	1	3	1	3	2	5	1	1	2	1	2	1	3	5	1	2	2	3	5	5	7
L741	50	1	3	1	2	2	5	1	1	2	1	2	1	2	5	1	1	1	5	5	3	7
WGP8	49	1	5	1	2	2	5	1	1	2	9	2	9	2	5	1	2	2	5	5	3	7
IH 07	57	1	5	1	3	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
G.Cot16	53	1	5	1	2	2	5	1	1	2	1	2	1	3	5	1	3	1	5	5	7	7
G.Cot100	55	1	3	1	3	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
L766	59	1	3	1	2	2	5	1	1	2	1	2	1	2	5	1	1	1	7	5	5	7
Tidewater5-3	53	1	3	1	3	2	5	1	1	2	1	2	1	3	5	1	2	2	5	5	5	7
G.ageti	53	1	3	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	3	7
NISD2	57	1	3	1	3	2	5	1	1	2	1	1	1	3	5	1	1	2	5	3	5	7
CPD478	51	1	3	1	2	2	5	1	1	2	1	2	1	2	5	1	1	1	5	3	1	7
A7262	58	1	3	1	2	2	5	1	1	2	1	2	1	3	5	1	2	2	5	5	3	7
PeeDee0113	55	1	3	1	2	2	5	1	1	2	1	1	1	2	5	1	1	2	3	5	5	7
TSH332	60	1	3	1	2	2	5	1	1	2	1	2	1	2	5	1	1	2	5	5	5	7
GJHV-01/35	61	1	3	1	2	2	5	1	1	2	1	2	1	2	5	1	1	2	5	5	7	7
Tx lama	49	9	5	3	3	4	5	9	9	6	1	2	1	4	5	2	1	2	5	5	5	7
010-1	55	1	5	1	2	2	5	1	1	2	1	2	1	3	5	1	2	2	5	3	5	7
F 2020	55	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
NA777	57	1	5	1	3	2	5	1	1	3	1	1	1	2	3	1	2	2	5	3	5	7
GSHY 97/13	52	1	5	1	2	2	5	1	1	2	1	1	1	3	5	1	2	2	3	3	7	7
IC 356932	54	1	5	1	2	2	5	1	1	3	1	2	1	2	5	1	2	2	5	5	3	7
IC357103	60	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	3	7
GISV-97/016	53	1	5	1	2	2	5	1	1	2	1	1	1	2	5	1	2	2	5	5	5	7
CCH 18	56	1	5	1	2	2	5	1	1	2	1	1	1	3	5	1	2	2	5	5	5	7
HLS 72	59	1	5	1	3	2	5	1	1	2	1	2	1	2	5	1	2	2	7	5	3	7
CRH 71	61	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
TXORHY-1-78	50	1	5	4	3	2	5	1	1	2	1	1	1	3	5	1	2	2	5	5	5	7
KDCAKD	57	1	5	1	2	2	5	1	1	3	1	2	1	3	5	1	2	2	7	5	3	5

Genotype	50% D	SP	SH	LS	LL	LC	LP	PP	SP	PC	P-spot	Stigma-P	FC	AC	BS	BC	B-shape	BT	FL	FS	FF	FU
CNH 120 MB	55	1	3	1	2	2	5	1	1	3	1	2	1	3	5	1	2	2	3	5	5	7
CPD 420	54	1	5	1	2	2	5	1	1	2	1	2	1	3	5	1	2	2	5	5	3	7
NH 577	54	1	5	1	2	2	5	1	1	3	1	2	1	3	5	1	3	2	5	5	5	7
NA 1584	58	1	5	1	3	2	5	1	1	2	1	1	1	3	5	1	2	2	5	5	5	7
CNH 7-94-2	52	1	5	1	2	2	5	1	1	2	1	1	1	3	5	1	2	2	5	5	5	7
ARB 9009	58	1	5	1	2	2	5	1	1	3	1	2	1	2	5	1	3	2	3	3	5	7
TCH 1218	57	1	3	1	2	2	5	1	1	2	1	1	1	2	5	1	1	2	5	5	5	7
Tashkent 3	55	1	5	1	3	2	5	1	1	2	1	1	1	3	5	1	1	2	5	5	5	7
G 204-13	54	1	5	1	3	2	5	1	1	2	1	2	1	2	5	1	1	2	5	5	5	7
Deltopine 66	58	1	5	1	3	2	5	1	1	2	1	2	1	2	5	1	3	2	5	5	3	7
AKH 9331	56	1	5	1	3	2	9	1	1	3	9	2	1	3	5	1	2	2	5	3	5	7
L 606	54	1	5	1	3	2	5	1	1	2	1	1	1	2	5	1	1	2	7	5	3	7
KH 121	58	1	5	1	3	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
ECV early	55	1	5	1	3	2	9	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
GSHY-01/1338	58	1	5	1	3	2	9	1	1	3	1	2	1	2	5	1	3	2	5	5	5	7
L 614	54	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	3	4
TSH 9907	58	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	5	5	5	7
Empire glandless	56	1	5	1	3	2	5	1	9	2	1	2	1	3	5	1	3	2	5	5	5	7
Rai 123	53	1	5	1	2	2	5	1	1	2	1	2	1	3	5	1	2	2	3	5	5	7
D6	60	1	5	1	3	2	9	1	1	2	1	2	1	3	5	1	2	2	5	5	5	7
RS 875	55	1	5	1	3	2	5	1	1	3	1	2	1	2	5	1	2	2	5	5	3	7
CCH-05-1	53	1	5	1	3	2	9	1	1	2	1	2	1	3	5	1	2	2	5	5	3	5
TSH 9904	51	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	3	5	5	7
MCU 11	56	1	5	1	3	2	5	1	1	2	1	2	1	3	5	1	2	2	5	5	3	7
TCH1599	54	1	5	1	3	2	9	1	1	2	1	2	1	3	5	1	2	2	5	5	5	7
TSH 9819	56	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	1	2	5	5	5	7
SA-53-1	58	1	5	1	3	2	5	1	1	2	1	1	1	3	3	1	2	2	5	3	5	7
L 713	59	1	5	1	2	2	5	1	1	2	1	2	1	2	5	1	2	2	7	5	3	5
F 2089	54	1	5	1	3	2	9	1	1	3	1	2	1	2	3	1	2	2	3	5	5	7
L 604 Sp	54	1	5	1	2	2	5	1	1	2	1	2	1	3	5	1	3	2	5	5	5	7

50% D : Days to 50% Flowering; SP : Stem Pigmentation (1= absent, 9=present); SH: Stem Hairiness (3= sparse ; 5= medium); LS: Leaf Shape (1 = palmate; 3 = okra): LL : Leaf Lobes (2 = three; 3= five); LC : Leaf Colour (2 = green, 4= dark red); LP : Leaf Pubescence (5 = medium; 9= strong); PP: Petiole Pigmentation (1 = absent, 9= present) SP: Sepal pigmentation (1= absent, 9 = present); PC: Petal Colour (2= cream, 3 = yellow, 6 = brown2009); Pspot :Petal Spot (1 = absent, 9 = present), Stigma P = Sigma position (1 = embedded; 2 = exserted); FC : Filament Colour (1 = absent, 9 = present); AC : Anther Colour (2 = cream, 3 = yellow, 4= purple); BS : Boll Size (3= small, 5= medium); BC : Boll Colour (1 = green, 2 = red); Bshape : Boll Shape (1 = round, 2 = ovate; 3 = elliptic); BT = Boll Tip (1= blunt;2= pointed); PH = Plant Height (3 = short-61-90 cm, 5 = medium, 91-120 cm) FL = Fiber Length (1 = very short- <20mm, 3 = short 20.5 – 24.5mm, 5 = medium 25-29mm, 7 = long 29.5-33.5mm 9-extra long > 33.5mm); FS = Fiber Strength (3 = weak-<20 gtex, 5 = medium 21.1-25.0 gtex, 7 = strong >25.0 gtex); FF= Fiber Fineness1 = very fine <3 , 3 = fine-3-3.9, 5 = medium 4-4.9, 7 = coarse 5-5.9, 9= very coarse >5.9); FU=Fiber Uniformity (3 = poor-<40, 5 = average- 42-45 , 7 = good->45).

dry matter accumulation. Presence of leaf gossypol glands is good for the plant as it had antibiosis effect on insects like *Spodoptera exigua* (army worm*), Helicoverpa zea* (Bollworm), black flea hopper or at least inhibits the growth of these insects (Bottger *et al.*, 1964). Nectariless cottons help in controlling the pink bollworm damage and also reduction in attack of tarnished plant bugs (Mc Carty *et al.*, 1983) but no line is showing this character.

Hairiness on the leaves and modified leaves are common cotton characteristic and among sixty lines, seven lines showed strong pubescence and 53 lines were medium in pubescence. Green leaf colour is a common characteristic and 59 lines showed the green leaf character and only one line (Tx Lama) showed the red colour leaf. Leaf lobes are five in 28 lines and three in remaining 32 lines. Leaf shape is okra in only one line (Tx Lama) and super okra in one line (TXORHY-1-78) and the remaining lines had normal palmate leaf shape which is conducive for the egg laying by bollworms.

Bract is normal and the number of serrations on the bract is many in all the lines. Sepal pigmentation is absent in 59 lines and only one line had red pigmentation (Tx Lama). The cream color is a common petal characteristic of upland cotton in 49 lines and yellow in 10 lines and brown in one line (Tx Lama). Petal spot is present only in two lines (WGP 8 and AKH 9331)) out of 60 lines which is a distinguishing character of Acala and Pima cottons and can be used as character for the parental or varietal identification. Stigma is exerted in most of the lines (47) and embedded in 13 lines. Filament coloration is absent in all the lines except in one line (WGP 8). Anther colour is cream in 34 lines and yellow in 25 lines and purple in one line (Tx Lama).

Boll bearing habit is solitary and boll size is medium in all the lines except in three lines (NA 777,SA 53-1 a nd F 2089). Boll colour is green in 59 lines and red in one line. Boll shape is round in 14 lines and elliptic in 7 lines and ovate in remaining lines. Boll prominence at tip is blunt in four and pointed in remaining 56 lines. Boll opening is open in all the lines. Plant habit is indeterminate in all the lines and is the common character in cotton.

The plant height showed variation from 63 to 117 cm among the lines. Most of the germplasm lines have the height of short stature but most of the breeding programmes would prefer to have plant heights of medium (90-120cm) to make them adoptable to picker harvesting.

The variability of the fiber properties in cotton is an unfavorable element in a market that pits this natural fiber against artificial more uniform products represented by synthetic fibers. Most of the germplasm lines evaluated *i.e.*, 46 were considered as having medium fiber length between 25.0 to 30.0mm while, 8 lines had short length and 6 lines showed long fiber length. Fifty six germplasm lines had good fiber uniformity and four had average to the fiber uniformity.

Fifty two lines had medium fiber strength (21.0 to 25.0g/tex) and eight lines had base strength of below 20.0g/tex. High fiber strength lines are desirable as fiber strength is directly correlated with yarn tenacity (Suh *et al.*, 1998). Thirty nine germplasm lines had medium fiber fineness and seventeen lines had fine fiber and three lines had coarse fiber and one line had very fine fiber characteristics. Allen (1998) reported that cotton with a micronaire value of 4.5 or greater is more desirable for use in non-woven roll goods as they have very few neps. It is well known that finer fabrics are more prone to nep formation.

The characterization of the germplasm using IBPGR descriptors is helpful for varietal identification and protection. The sixty lines are reservoirs for different parameters and they can be exploited for different breeding programmes for breeding pest resistance and quality parameters.

Acknowledgements

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