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RESEARCH ARTICLE

Evaluation of eco-friendly naturally coloured *Gossypium hirsutum* L. cotton genotypes

■ ANIL B. BASAVARADDER AND MANJULA S. MARALAPPANAVAR

SUMMARY

In the study carried out during *Kharif* 2012-13, fourteen naturally brown coloured (*Gossypium hirsutum* L.) cotton (ten medium brown and four dark brown) genotypes along with two checks DMB-225 (Dharwad Medium Brown) and DDB-12 (Dharwad Dark Brown) developed at Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka, India, were used as research material. The aim of this study was to determine seed cotton yield, yield attributing traits and major lint quality traits of investigated coloured cotton genotypes. Field trial was conducted in Randomized Block Design with two replications. According to the results, medium brown and dark brown coloured cotton genotypes exhibited variation for yield, yield attributing and fibre quality traits.

Key Words : Naturally coloured cotton, Seed cotton yield, Yield components, Fibre quality parameters

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In nature, colour and white linted cottons are found from time immemorial. As evidenced from excavation of Huaca Prieta on the northern Peruvian Coast of South America indicated the usage and cultivation of colour cotton since 2500 B.C., lint samples recovered from this area were brown, chocolate, blue, purple, green, tan, red and creamy white (Stephens, 1975, Apodaca, 1990 and Manjula, 2005). Naturally colour cottons do not have to be dyed in fabric manufacturing. Naturally colour cottons are presently grown in China, Peru, Israel and India. Naturally coloured cottons are a very small niche market. Now China is the largest colour cotton producing country and known for its spinning and weaving processes (Dong-Lei Sun *et al.,* 2009 and Anonymous, 2010). The naturally coloured cotton genotype of India, DDCC-1 (*Gossypium arboreum* L.) with almond colour lint is a marvel of genetic amelioration in fibre colour, by Agriculture Research Station, University of Agricultural Sciences, Dharwad and cultivated commercially in this region on contract farming. The research efforts were also done in bringing out improved *Gossypium hirsutum* L. naturally colour cotton genotypes with improved yield potential and fibre quality with stable colours of brown shades and green types. Medium brown colour cotton genotype DMB-225, dark brown cotton genotype DDB-12 and green colour genotype DGC-78 were developed at ARS, Dharwad and registered at National Bureau of Plant Genetic Resources (NBPGR) during the year 2012-13 (Manjula *et al.,* 2011 and 2013).

The fibres of coloured cottons presently available are shorter, weaker and finer than regular upland cotton and can be blended with normal white cottons. Generally, colour linted varieties are poor yielders having low productivity per unit area due to smaller bolls and low ginning outturn. High whiteness per cent, higher wax content, requirement of isolation distance, existence of only a few shades, inconsistency and non-uniformity of fibre colour over seasons

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
MANJULA S. MARALAPPANAVAR, All India Co-ordinated Cotton Improvement Project, Agricultural Research Station, DHARWAD (KARNATAKA) INDIA
Email: manjula_arsd@yahoo.co.in, manjula_ars@rediffmail.com

Address of the Co-authors:
ANIL B. BASAVARADDER, Department of Genetics and Plant Breeding, College of Agriculture, University of Agricultural Sciences, DHARWAD (KARNATAKA) INDIA

and locations are few other problems associated to these cottons. To make these ecofriendly colour cotton commercially viable; research efforts need to be directed for the genetic improvement of the agronomic traits, fibre quality and uniform colour. Few studies have been done in this direction but there is a long way to go to make them agronomically at par with white cultivars.

MATERIAL AND METHODS

In the study carried out during *Kharif* 2012-13 at Agricultural Research Station, Dharwad farm, fourteen naturally coloured cotton (*Gossypium hirsutum* L.) genotypes consisting of ten medium brown {MB-1013; MB-1023; MB-1043; MB-1053; MB-1063; MB-1073; MB-1083; MB-1093; MB-102 (3) and MB-104(3)} and four dark brown (DB-1034, DB-1104, DB-1014; DB-1054) genotypes along with two checks DMB-225 (Dharwad Medium Brown) and DDB-12 (Dharwad Dark Brown) were evaluated in Randomized Block Design with two replication following row to row and plant to plant spacing of 90 and 60 cm, respectively. In each plot the observations were recorded on five random plants in respect of days to 50 per cent flowering, days to first boll opening, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, per boll weight and seed index. During harvest twenty fully opened bolls from each plot were handpicked and weighed to compute the means for per boll weight. The yield of five plants was used to compute the mean seed cotton yield of plot. Fibre quality parameters such as fibre length, fibre fineness and fibre strength of fibre samples were determined using HVI (High Volume Instrument) analyzer. Data obtained were subjected to RBD analysis using Windostat 8.5 version package programme. Variability parameters for different quantitative traits were also calculated.

RESULTS AND DISCUSSION

According to the results obtained, the genotypes studied showed statistical significance for important yield and yield attributing traits such as boll weight, plant height, number of sympodia, number of bolls per plant, ginning out turn, seed index, lint index and seed cotton yield (Table 1).

Mean *per se* performance of yield and yield attributing traits of medium and dark brown coloured cotton genotypes. Among medium brown coloured cotton genotypes for mean *per se* performance of yield, none of them were significantly superior to the medium brown check DMB-225 (1845 kg/ha). Medium brown genotypes MB-1073 and MB-1053 recorded significantly superior boll weight (3.0 and 2.9 g, respectively) over the check MB-225 (2.4 g). Genotype MB-1093 recorded significantly high number of sympodia per plant (21.85 numbers) compared to the check DMB-225 (17.3 numbers). All the genotypes falling under medium brown colour class were significantly superior for ginning out turn (GOT %) to the check DMB-225 (34.45%). For fibre length, genotypes MB-1043 (25.28 mm), MB-1043 (21.67 mm), MB-1083 (21.51 mm) and MB-1073 (21.28 mm) recorded significantly superior over the check DMB-225 (20.24 mm). Genotype MB-1093 recorded highest fibre strength (26.1 g/tex) and MB-1053 (24.5 g/tex), MB-1023 (24.1 g/tex), MB-1013 (23.7 g/tex) was also found superior as against DMB-225 (22.3 g/tex).

In dark brown coloured cotton genotypes, the genotype DB-1054 recorded highest seed cotton yield (15.97 q/ha) over the check DDB-12 (13.05 q/ha). None of the genotypes were significant for boll weight over the check DDB-12 (2.75 g). Genotypes DB-1104 (39.63 %) and DB-1054 (38.09 %) were significantly superior for ginning out turn over the check DDB-12 (34.71 %). Fibre quality parameters in dark brown genotypes, none of the genotypes were significantly better than the check DDB-12 (20.84 mm) for fibre length. All the dark brown genotypes, DB-1039 (25.3 g/tex), DB-1104 (24.6 g/tex), DB-1014 (24 g/tex) and DB-1054 (22.7 g/tex) were significantly superior to the check DDB-12 (20.9 g/tex) as detailed in Table 2 and graphical representation in Fig. 1.

The findings of yield and its component traits in the study were in agreement with research findings of Mandloi *et al.*,1996 Khadi *et al*., 1996b; Ravinderanath *et al*., 1996; Bijapur, 1996 and Manjula *et al*., 2011 who reported that boll weight in naturally colour cottons varied from 1.5 to 4.5 g, seed cotton yield ranged from 2600 to 2900 kg/ha. Increase or decrease in seed cotton yield may be explained by genotypic variation, different edaphic and climatic conditions. Seed index varied from 5.0 to 11.0 g, range for lint index was from 1.75 to 6.74 g and range for ginning out turn recorded from 18.6 to 42.8 per cent.

Our research findings related to fibre traits were in line with those of Krishna Iyer *et al*., 1996; Mandloi *et al.*, 1996; Narayanan *et al*., 1996; Singh *et al.*, 1996 and Manjula *et al*., 2011 who reported that fibre length in dark brown cottons

Table 1: Analysis of variance for yield and yield attributing traits in stabilized genotypes of colour cotton

Source of variation	d.f.	Days to 50% flowering	Days to boll open	Boll weight (g)	Plant height (cm)	No. of sympodia /plant	No. of monopodia /plant	No. of bolls/ plant	Ginning outturn (%)	Seed index (g)	Lint index (g)	Seed cotton yield (q/ha)
						Mean sum of squares (MSS)						
Replications	1	13.78*	3.13	0.02	15.68	0..85	0.02	0.053	0.044	0.002**	0.004**	0.26
Genotypes	15	28.19**	11.67**	0.084**	147.13**	3.88**	0.16**	16.14**	9.29**	0.413**	0.39**	12.59**
Error	15	5.45	1.59	0.009	2.86	0.8	0.03	3.49	0.079	0.0005	0.0003	1.72

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2: Mean performance of stabilized colour cotton genotypes

Sr. No.	Genotypes	DF	DBO	BW (g)	PH (cm)	NS	NM	BPP	GOT %	SI (g)	LI (g)	SCY (q/ha)	UHML (mm)	UI	Micronaire value	Tenacity (g/tex)	Elg. %	Score for lint color
1.	MB-1073	71.0	133	2.9	113.3	19.1	1.9	18	37.89	5.77	3.52	15.75	21.28	75.4	3.37	21.0	6.7	3
2.	MB-104(3)	81	140	2.7	117.4	19	2.5	20	40.25	6.67	4.45	15.72	25.28	80.7	3.15	20.5	6.2	3
3.	MB-1053	70.0	137	3.0	93.3	17.0	1.7	17	38.44	6.78	4.20	14.50	18.94	75.6	3.48	24.5	6.9	3
4.	MB-1083	71.5	133.5	2.6	103.5	17.85	1.9	18	41.03	6.25	4.35	13.34	21.51	76.5	2.78	19.8	6.7	3
5.	MB-102(3)	72	136	2.55	108.9	18.6	1.3	15	37.80	6.17	3.76	11.78	20.44	77.5	2.73	22.0	6.9	3
6.	MB-1023	78.5	136.5	2.5	110.1	17.4	1.7	19	40.38	5.70	3.87	11.12	19.34	74	3.03	24.1	7.0	3
7.	MB-1093	71.0	134	2.25	115.0	21.85	1.3	19	40.12	5.23	3.56	10.80	18.50	77.5	3.13	26.1	6.8	3
8.	MB-1013	70.0	133.5	2.5	107.2	17.6	1.5	13	36.88	6.43	3.79	10.69	19.45	78	2.84	23.7	6.9	3
9.	MB-1043	70.0	133	2.65	104.8	16.9	1.7	16	38.46	6.67	4.16	10.09	21.67	76.4	2.7	20.2	6.6	3
10.	MB-1063	72.0	136.5	2.6	111.6	18.3	1.5	15	36.99	5.71	3.36	9.55	20.66	78.3	2.54	21.0	6.9	3
11.	DB-1054	71	133	2.25	92.6	16.5	1.5	19	38.09	5.49	3.39	15.97	18.53	73.4	3.06	22.7	7.1	4
12.	DB-1014	74	137	2.45	88.5	16.5	1.7	18	35.88	5.82	3.27	14.48	19.23	75.8	2.86	24	7.1	4
13.	DB-1104	73	134	2.50	102.6	17.6	1.5	18	39.63	5.63	3.72	14.42	19.23	76.3	3.1	24.6	6.9	4
14.	DB-1034	71	136.5	2.45	109.9	19.2	1.5	18	34.49	5.89	3.14	12.64	19.50	78.2	2.76	25.3	6.8	4
Checks	DMB-225	81	140	2.4	94.5	17.3	1.7	26	34.45	5.89	3.09	18.45	20.24	78	2.51	22.3	6.9	3
	DDB-12	75.5	138.5	2.75	106.4	19.5	1.5	20	34.71	5.82	3.14	13.05	20.84	77.1	2.83	20.9	6.9	4

DF – Days to 50% flowering; DBO – Days to boll open; BW – Boll weight; PH – Plant height; NS – Number of sympodia
NM – Number of monopodia; BPP – Bolls per plant; GOT – Ginning outturn; SI – Seed index; LI – Lint index
SCY – Seed cotton yield; 2.5% SL – 2.5% span length; UI – Uniformity Index; Elg. - Elongation %

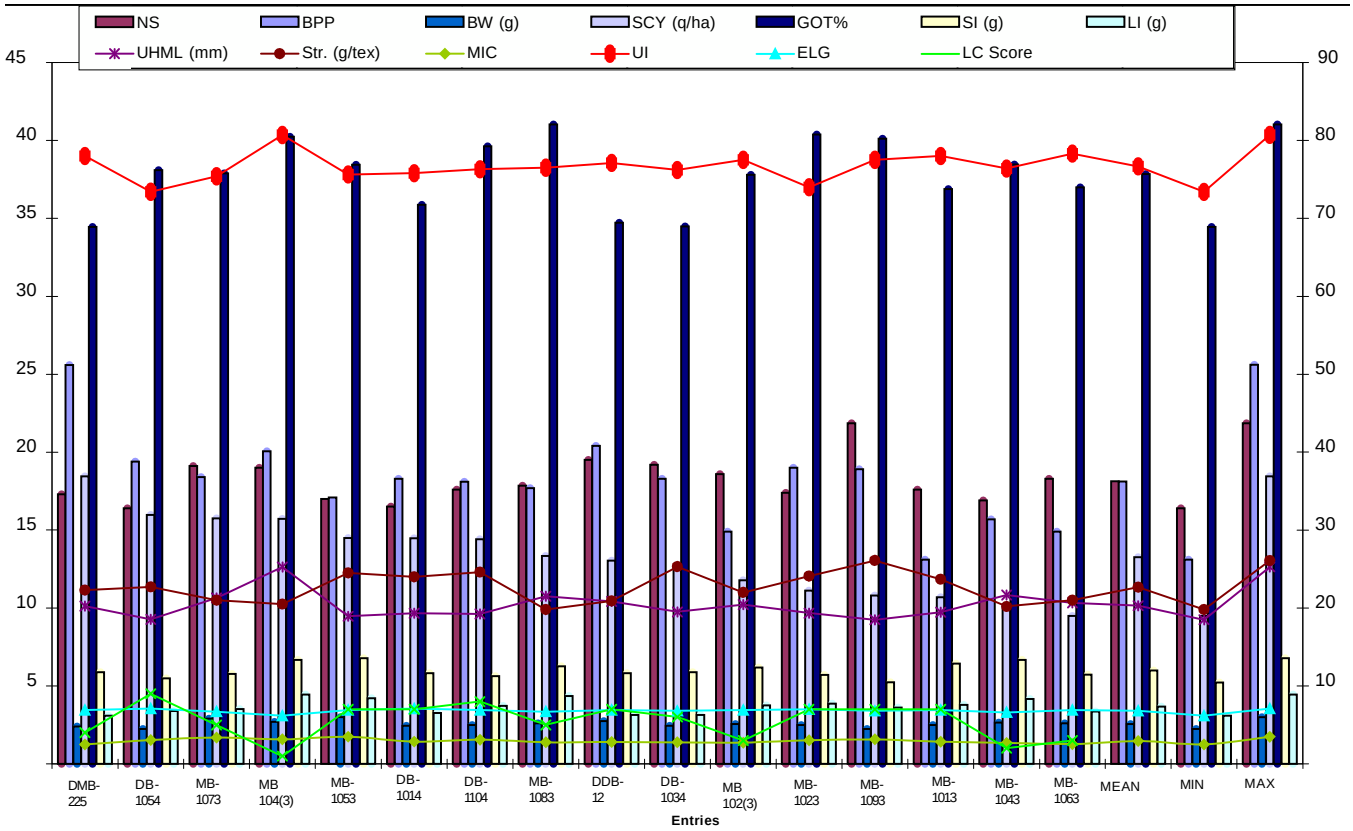

Fig. 1: Representation of yield and fibre quality parameters in stabilized colour cotton genotypes

varied from 16.0 to 27 mm; range observed in medium brown was from 20.4-26.2 mm which supports our findings; in light brown Gurel *et al*., 2001 reported fibre length ranging from 30.2 to 33.9 mm and in cream cotton fibre length reported was 24.1-26.6 mm. The shortest fibres were observed in deep brown category and quality parameter indicated that darker the fibre shorter will be the fibre due to variation during fibre development for cellulose and pigment deposition synchronize leading to poor fibre quality. Few studies report higher fibre length than our findings. Fibre strength values observed in our findings were in line with those of Singh *et al.* (1996); Narayanan *et al*. (1996); Lale Efe *et al.* (2009) and Manjula *et al*. (2011) who reported that tenacity of varied from 13.1 to 19.8; 15.5 to 21.5; 26.7 and 19.0 to 27.9 g/tex in dark brown,

Table 3: Variability and heritability parameters in stabilized colour cotton genotypes

Parameter		Days to 50% flowering	Days to boll open	Boll weight (g)	Plant height (cm)	No. of sympodia /plant	No. of monopodia /plant	No. of bolls/ plant	Ginning outturn (%)	Seed index (g)	Lint index (g)	Seed cotton yield (q/ha)
GCV (%)		4.60	1.65	7.52	8.10	6.82	15.73	13.88	5.67	7.58	12.03	17.57
PCV (%)		5.12	1.78	7.98	8.18	7.68	17.43	15.68	5.09	7.58	12.04	18.90
h^2bs (%)		80	86	89	98	79	815	78	99	99	99	86
GA (5%)		6.24	4.29	0.37	17.33	2.26	0.48	4.58	4.40	0.94	0.90	4.46
GAM		8.52	3.17	14.61	16.52	12.49	29.24	25.30	11.63	15.62	24.78	33.62
S.E.D		2.33	1.26	0.09	1.69	0.90	0.18	1.87	0.28	0.007	0.017	1.313
S.E.M		1.59	0.86	0.06	1.16	0.61	0.12	1.28	0.19	0.005	0.011	0.89
C.V. %		3.185	0.93	3.7613	1.613	4.99	10.61	10.32	0.743	0.1216	0.454	9.89
C.D. 5%		4.98	2.69	0.206	6.60	1.93	0.373	3.99	0.599	0.0155	0.035	2.79
C.D. 1%		6.88	3.72	0.284	4.98	2.67	0.516	5.51	0.828	0.215	0.049	3.87
Mean		73.3	135.75	2.56	104.85	16.4	1.65	18	37.84	5.99	3.67	13.27
Range	Min.	70	133	2.25	88.5	16.5	1.3	13	34.45	5.23	3.09	9.55
	Max.	81	140	3	117.4	21.85	2.5	26	41.03	6.78	4.45	18.45

***YB-Yellow brown**

*** OB- Orange brown**

***YB-Yellow brown**

*** LYB- Light yellow brown**

Plate 1 and 2: Lint colour of stabilized cotton with entry name followed by colour code given by using RHS colour chart

medium brown, light brown and cream cotton, respectively. The difference in the reports may be originated due to genotypes. Essentially, fibre length and strength can vary in different cultivation practices and different environments besides of genotypes (Dutt *et al.,* 2003).

Moderate to low level of genetic variability was observed for the characters studied in the genetic material handled (Table 3). The study revealed moderate genotypic and phenotypic co-efficient of variation for number of bolls per plant, lint index and seed cotton yield. Similar findings were reported by Singh *et al.,* 1996; Mandloi *et al*., 1996 and Bijapur, 1996 for number of bolls per plant. However, low variation was observed for per boll weight, plant height, number of sympodia, ginning out turn and seed index, indicating narrow genetic base for the traits. Heritability estimate is important because genotypic co-efficient of variation doesn't give the idea of total variation *i.e.*, heritable. Heritability and genetic advance estimation give an idea about relative amount of heritability and give an idea about the effectiveness with which selection can be practiced for genetic improvement of a particular character based on phenotypic performance. High heritability coupled with high genetic advance observed for number of bolls per plant indicated the possibility of improvement of this trait through selection. This indicates that there was low environmental influence on the expression of these characters and hence, one can practice selection in these traits. Similar findings were reported by Bijapur (1996). High heritability coupled with low genetic advance was observed for per boll weight, number of sympodia, ginning out turn, seed cotton yield, seed and lint index. These genotypes need to be tested in replicated trials at various location with isolation to avoid contamination of white cotton types and the genotypes proven to be superior can be used as a variety and as parents in hybridization programmes.

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