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Identification of Superior Rils for Fibre Quality, Seed Cotton Yield and Its Component Traits

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ABSTRACT

The two hundred recombinant inbred lines derived from cross between G. hirsutum var. DS-28 and G. barbadense var. SBYF-425 were evaluated across four testing environments at Agriculture Research Station, Dharwad during 2011-12, 2012-13 and 2013-14 and at Agriculture Research Station, Baglkot during, 2013-14. DHBR-25, DHBR-43 , DHBR-81, DHBR-161, DHBR-128 , DHBR-156 , DHBR-20, DHBR-88, DHBR-58 , DHBR-153 recorded significantly higher seed cotton yield than best parent DS-28 (853.56 kg/ha) and commercial check, Sahana (1025.63 kg/ha) accounting 21.72 to 44.72 per cent more seed cotton yield. Among these superior high yielding genotypes, three genotypes like DHBR-161, DHBR-20 and DHBR-88 recorded significantly higher fibre strength with desired level of micronaire value. The genotype DHBR-20 (1313.78 kg/ha; 24.18 g/tex) recorded significantly higher seed cotton yield with significantly higher fibre strength and on par with commercial check, Sahana (1025.63 kg/ha; 21.52 g/tex) and MCU-5 (659.49 kg/ha; 23.13 g/tex) for other traits like ginning out turn and boll weight. It indicates the possibility of simultaneous improvement for both seed cotton yield and fibre strength through interspecific hybridization.

Key words: *Recombinant inbred line, Augmented design and Hybridization, Tetraploid.*

INTRODUCTION

Cotton is considered as commercial cash crop, most important textile fibre crop, and world's second-most important oil-seed crop. It is grown commercially in the temperate and tropical regions of more than 50 countries, the United States, India, China, Central and South America, the Middle East, and Australia. Cotton seed and lint are used in variety of application in food, feed and industrial products. Cotton considered as a backbone of our sprawling textile industry and provides employments approximately 50 million people in activities related to its cultivation, processing and trade, contributing 4.4 per cent to our GDP, fetching export earnings. It accounts for 45 per cent of the world fibre and supplies 10 per cent world edible oil. India considered as largest cotton growing area of 115.53 lakh hectare with production of 375.00 lakh bales of 170 kg cotton lint with average productivity of 552 kg per hectare.

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Karnataka have the production of 18.00 lakh bales cotton lint from 5.78 lakh hectares of area with productivity of 529 kg per hectare[1].

Demand for enhancement of fiber quality traits such as fiber length and fiber strength have been increasing because of the changes in spinning technology of the textile industry; however, most commercial cultivars although high yielding, but lack some of the desirable fiber quality traits. The primary breeding goal for the worldwide cotton researcher is to genetically improve both yield and fiber quality simultaneously. It could be possible through interspecific hybridizations. Successful history to develop interspecific hybrid through hybridization was develop a desirable genetic resource[2,11]. Mention may be made here of successful varieties MCU-2, MCU-3 and MCU-5 of inter-specific origin in Madras.

Among the four cultivated species, *G.hirsutum* species, occupies highest area in India (92 per cent area) as well as in the whole world, because of its high yielding ability with a range of spinning potentiality from these 20s-50s count. However, most superior fibre quality species is *G. barbadense* which produces raw cotton suitable for spinning to more than 50s-120s count, but it is very shy yielder. In India high yielding potentiality of *G.hirsutum* and high fibre quality of *G. barbadense* have been exploited through heterosis breeding by cultivating interspecific hybrid between these two species commercially. Use of *G. barbadense* L. in breeding programme to improve *G. hirsutum* L. was attempted by several workers like Chaoyou *et al*[3]., Katageri *et al*[7]., Zeng *et al*[11]., Choudki *et al*[4]., and Choudki *et al*[5]. In the present study, tried to evaluate diverse recombinant inbred lines (RILs) derived from most commercially exploited interspecific hybrid DCH-32 for finding out high yield potential with high fibre quality trait RILs.

MATERIALS AND METHODS

Dharwad Hirsutum Barbadense Recombinant inbred (DHBR) lines of advance generation RILs derived from cross between *G. hirsutum* var. DS-28 and *G. barbadense* var. SBYF-425[7]. Two hundred DHBR lines, parents (DS-28 and SBYF-425) and check varities *viz.*, Sahana, Surabhi, MCU-5 wre evaluated at Agriculture Research Station, Dharwad, during 2011-12, 2012-13, 2013-14 and at Agriculture Research Station, Bagalkot during 2013-14. All the seeds were treated with Imidacloprid to protect the crop from the incidence of sucking pests during early growth stage. Seeds were hand dibbled in rows of each 6 m length with spacing of 90 cm between rows and 20 cm between plants, in Augmented Design-II with 10 blocks, each block 25 entries including checks. Checks were repeated in each block. Same design was followed across all environments and recommended package of practices were followed to raise good crop.

Mean of five plants observations and mean of four testing environments of data were subjected to augmented design analysis[6] for yield and yield contributing and fibre quality traits using Windostat version 9.2 software and analysis of variance and mean per se performance was calculated.

Plant height was measured in centimeters from the base of the plant to the apex of the plant at boll opening stage. Number of branches on main stem which were lateral and axillary in position with vertical growth in acropetal succession was counted at boll opening stage; avoiding small sprouts were taken as monopodia.

Branches which are extra axillary in position and normally horizontal with zigzag pattern of fruiting points were taken as sympodia. Before picking of kapas, number of bolls were counted from the selected plants and determine the per plant boll number. First open 20 good bolls selected randomly were harvested by hand from randomly selected plants of each plot and determined per boll weight and expressed in grams. Total seed cotton yield harvested from all picking of each plot area were weighed by electronic weighing balance and expressed in kilo gram per hectares. The harvested kapas were ginned by Lilliput ginning machine and determined the ginning out turn and expressed in percentage. This was calculated by using the formula.

$$\text{Ginning out turn } (\%) = \frac{\text{Weight of lint (g)}}{\text{Weight of seed cotton (g)}} \text{ x } 100$$

Seed index was determined by weight of 100 seeds expressed in grams. Lint index is the weight of lint obtained from 100 seeds and expressed in grams. This was calculated by using the formula.

$$\text{Lint index } = \frac{\text{Seed index X Ginning out turn}}{100 - \text{Ginning out turn } (\%)}$$

Fibre quality was analyzed at Central Institute for Research on Cotton technology (CIRCOT), Regional quality evaluation unit situated at Agricultural Research Station, University of Agricultural Sciences, Dharwad (India), using High volume instrument (HVI).

RESULTS AND DISCUSSION

The analysis of variance indicated presence of significant difference among the recombinant inbred lines for all the trait *viz.*, monopodia per plant, sympodia per plant, bolls per plant, boll weight, seed index, lint index, ginning out turn, seed cotton yield, 2.5 % span length, fibre strength, micronaire value, fibre uniformity ratio, maturity ratio and fibre elongation, except plant height (Table 1).

Mean per se performance was assessed across four testing environments. Ten recombinant inbred lines like DHBR-25 (1484.25 kg/ha), DHBR-43 (1456.38 kg/ha), DHBR-81 (1430.15 kg/ha), DHBR-161 (1405.84 kg/ha), DHBR-128 (1362.55 kg/ha), DHBR-156 (1342.19 kg/ha), DHBR-20 (1313.78 kg/ha), DHBR-88 (1299.97 kg/ha), DHBR-58 (1255.63 kg/ha), DHBR-153(1248.35kg/ha) recorded significantly higher seed cotton yield than best parent DS-28 (853.56 kg/ha) and commercial check, Sahana (1025.63 kg/ha) accounting to 21.72 to 44.72 per cent more seed cotton yield, which indicates the recovery of transgressive segregants for seed cotton yield. Among these superior high yielding genotypes like DHBR-161 (22.60 g/tex), DHBR-20 (24.18 g/tex), DHBR-88 (22.47 g/tex) recorded significantly higher fibre strength with desired level of micronaire value (Table 2). Similar type of results was observed by Soregaon9, Soregaon *et al*[10]., Choudki *et al*[4,5]., and Soomro *et al*[8].

Finding out genotype with high yielding ability and with other desirable traits is always difficult task; the possibility of recovering such genotypes is recorded in this study. The genotype DHBR-20 (1313.78 kg/ha; 24.18 g/tex) recorded significantly higher seed cotton yield with significantly higher fibre strength than Sahana (1025.63 kg/ha, 21.52 g/tex) and on par with MCU-5 (659.49 kg/ha; 23.13 g/tex) for fibre strength and other traits like ginning out turn and boll weight. There are good number of lines which significantly higher trait value than commercial check or better parent of these lines was observed. Genotype like DHBR-116 recorded significantly higher ginning out turn (44.18 %) and higher fibre strength (22.11 g/tex) but, showed significantly low seed cotton yield than commercial check Sahana (39.07 %) (Table 3). DHBR-31 (24.66 g/tex), DHBR-20 (24.18 g/tex), DHBR-192 (24.16 g/tex), and DHBR-146 (24.14 g/tex) recorded significantly higher fibre strength than Sahana (21.52 g/tex) but on par with MCU-5 (23.13 g/tex). However, they recorded significantly lower seed cotton yield than Sahana (1025.63 kg/ha) except DHBR-20 (1313.78 kg/ha) which recorded significantly higher seed cotton yield than Sahana (Table 4). These identified superior DHBR lines can be directly utilized for commercial cultivation after large scale testing and as a breeding material for improvement of seed cotton yield and fibre quality traits in cotton.

Table 1: Analysis of variance for yield, yield contributing and fibre quality traits

Source of variation		**Mean sum of squares**														
Components / Traits	**DF**	**Plant height (cm)**	**Monopodia /plant**	**Sympodia /plant**	**Bolls /plant**	**Boll weight (g)**	**Seed index (g)**	**Lint index (g)**	**Ginning out turn (%)**	**Seed cotton yield (kg/ha)**	**2.5 % Span length (mm)**	**Fibre strength (g/tex)**	**Micronaire value (µg/in)**	**Uniformity ratio (%)**	**Maturity ratio**	**Fibre elongation (%)**
Block	9	252.19	0.01	0.46	2.47 **	0.02	0.35	0.10	2.39	21055.72 *	1.59 *	0.488	0.002	0.58	0.06 *	0.03
RILs + Checks	204	224.48	0.10 **	2.02 **	5.49**	0.30 **	0.52 **	0.44**	8.78 **	101512.40**	2.38**	1.39 **	2.27**	1.69**	1.90**	0.08**
Checks	4	1268.09 **	0.57**	13.86**	3.99**	2.46 **	2.29**	3.61**	38.54 **	1517397.00**	24.84 **	9.99 **	0.30 **	17.33**	0.63 ***	0.36**
RILs	199	74.93	0.08**	1.79 **	5.54 **	0.22**	0.48 *	0.38 **	8.20**	73318.16**	1.72 ***	1.009 *	0.11 **	1.32**	0.001 **	0.07**
Checks vs RILs	1	25811.28 **	2.47**	0.35	0.11	8.38**	1.17 *	1.27 **	3.75	48619.60*	43.27**	43.06**	439.55 **	13.54 **	386.21 **	0.42**
Error	36	220.33	0.007	0.84	0.41	0.04	0.26	0.08	1.37	7193.80	0.60	0.541	0.002	0.40	0.02	0.01
Ci-Cj (CD@5%)	1	13.12	0.07	0.83	0.58	0.19	0.47	0.26	1.06	76.92	0.70	0.667	0.041	0.57	0.14	0.11
Ci-Vj (CD@5%)	1	34.84	0.20	2.15	1.50	0.50	1.21	0.692	2.74	199.12	1.82	1.727	0.107	1.49	0.38	0.30

*Significant at 5% probability level **Significant at 1% probability level

Table 2: Promising recombinant lines for seed cotton yield (kg/ha)

DHBR lines	Seed cotton yield (kg/ha)	per cent increase over Sahana	Boll weight (g)	Bolls /plant	Ginning out turn (%)	Plant height (cm)	Monopodia /plant	Sympodia /plant	Seed index (g)	Lint index (g)	2.5 % Span length (mm)	Uniformity ratio (%)	Maturity ratio	Micronaire value (µg/in)	Fibre strength (g/tex)	Fibre elongation (%)
DHBR-25	1484.25*	44.72	4.49	10.49	31.16	105.25	1.43	17.12	8.91	4.26	27.63	47.63	0.71	3.67	22.36	5.39
DHBR-43	1456.38*	42.00	4.26	11.03	34.56	97.89	1.50	15.37	9.16	4.94	26.10	48.66	0.67	3.84	22.19	5.36
DHBR-81	1430.15*	39.44	4.22	10.54	35.29	81.37	1.49	14.46	9.06	5.13	25.49	47.76	0.67	4.24	20.21	5.34
DHBR-161	1405.84*	37.07	4.16	12.74	34.95	71.51	1.49	15.68	10.22	5.53	29.17	47.94	0.63	3.45	22.60	5.66
DHBR-128	1362.55*	32.85	2.91	16.04	35.80	55.59	1.99	14.22	7.12	3.89	25.20	43.49	0.64	4.35	20.32	5.56
DHBR-156	1342.19*	30.86	3.19	13.78	33.92	77.80	1.85	14.36	8.28	4.24	26.54	47.39	0.69	3.71	21.39	5.54
DHBR-20	1313.78*	28.09	4.07	11.13	36.46	92.39	1.67	15.41	9.41	5.44	28.32	49.14	0.70	3.68	24.18	5.88
DHBR-88	1299.97*	26.75	3.83	12.72	36.48	81.35	1.42	17.21	9.64	5.67	27.85	48.52	0.68	4.17	22.68	5.68
DHBR-58	1255.63*	22.43	3.84	11.87	32.02	88.48	0.97	17.95	9.80	4.65	27.95	47.35	0.71	4.02	21.47	5.36
DHBR-153	1248.35*	21.72	4.37	10.29	40.32	80.41	1.82	14.38	9.47	6.30	25.30	48.90	0.71	4.35	20.86	5.54
DS-28	853.56	-	4.55	9.71	37.99	77.48	1.53	14.89	8.50	5.33	26.58	46.70	0.64	3.80	20.75	5.49
SBFY-425	91.49	-	3.25	8.84	31.89	77.22	1.65	15.00	10.24	4.41	32.99	47.94	0.61	3.05	25.98	5.54
Sahana	1025.63	-	4.51	9.38	39.07	86.04	1.67	15.83	9.44	5.69	27.25	46.79	0.65	3.64	21.52	5.57
Surabhi	657.42	-	4.52	10.14	39.07	80.30	1.65	18.11	8.56	4.95	28.51	47.02	0.64	3.63	22.90	5.66
MCU-5	659.49	-	4.08	11.09	35.78	91.52	2.19	16.17	9.00	5.22	29.37	46.77	0.67	3.53	23.13	5.84
CD@5%	199.12	-	0.5	1.5	2.74	34.84	0.2	2.15	1.21	0.692	1.82	1.49	0.38	0.107	1.727	0.3
CV (%)	19.29	-	12.9	20.51	8.28	10.49	19.05	8.54	7.82	12.8	4.82	2.42	4.3	8.88	4.68	5.02

*Significant higher yield over Sahana

Table 3: Promising recombinant inbred lines for ginning out turn (%)

DHBR lines	Ginning out turn (%)	Seed index (g)	Lint index (g)	SCY (kg/ha)	Boll wt (g)	Bolls /plant	plant height (cm)	Monopodia /plant	Sympodia /plant	2.5 % Span length (mm)	Uniformity ratio (%)	Maturity ratio	Micronaire value (μg/in)	Fibre strength (g/tex)	Fibre elongation (%)
DHBR-116	44.18*	9.36	5.68	748.86	3.10	15.69	78.40	1.30	13.58	26.03	48.80	0.63	4.18	22.11	5.13
DHBR-188	40.36	8.70	5.98	685.10	3.07	11.69	74.70	1.89	14.13	26.04	47.19	0.65	3.84	20.46	5.75
DHBR-153	40.32	9.47	6.30	1248.35	4.37	10.29	80.41	1.82	14.38	25.30	48.90	0.71	4.35	20.86	5.54
DHBR-39	39.95	9.04	5.54	773.12	4.19	8.72	88.50	1.60	16.21	28.35	45.97	0.66	4.09	20.11	4.95
DHBR-126	39.79	8.19	4.66	707.17	3.43	12.80	78.54	1.56	16.27	26.13	48.75	0.62	3.62	22.01	5.34
DHBR-150	39.49	8.81	5.46	1135.92	3.27	12.98	79.12	1.50	17.23	26.03	48.04	0.68	3.92	21.19	5.57
DHBR-69	39.34	8.44	5.61	692.43	3.37	12.02	74.95	1.40	12.99	27.20	47.77	0.67	3.85	21.69	5.49
DHBR-61	39.10	9.56	6.11	902.19	4.18	11.81	80.88	1.22	14.92	29.94	47.63	0.67	3.94	22.29	5.39
DHBR-173	39.02	7.71	4.97	792.37	3.06	17.28	82.38	1.73	14.51	26.73	48.31	0.64	3.62	21.33	5.70
DHBR-152	38.95	7.50	5.30	541.98	3.08	10.64	89.39	1.28	16.45	25.84	48.38	0.72	4.70	20.36	5.30
DHBR-119	38.63	7.70	4.89	477.51	3.03	12.09	59.63	1.14	12.51	24.90	49.34	0.70	4.63	21.25	5.33
DS-28	37.99	8.50	5.33	853.56	4.55	9.71	77.48	1.53	14.89	26.58	46.70	0.64	3.80	20.75	5.49
SBFY-425	31.89	10.24	4.41	91.49	3.25	8.84	77.22	1.65	15.00	32.99	47.94	0.61	3.05	25.98	5.54
Sahana	39.07	9.44	5.69	1025.63	4.51	9.38	86.04	1.67	15.83	27.25	46.79	0.65	3.64	21.52	5.57
Surabhi	34.18	8.56	4.95	657.42	4.52	10.14	80.30	1.65	18.11	28.51	47.02	0.64	3.63	22.90	5.66
MCU-5	35.78	9.00	5.22	659.49	4.08	11.09	91.52	2.19	16.17	29.37	46.77	0.67	3.53	23.13	5.84
CD@5%	2.74	1.21	0.692	199.12	0.5	1.5	34.84	0.2	2.15	1.82	1.49	0.38	0.107	1.727	0.3
CV (%)	8.28	7.82	12.84	19.29	12.89	20.51	10.49	19.05	8.54	4.82	2.42	4.30	8.88	4.68	5.02

*Significant higher ginning out turn over MCU-5

Table 4: Promising recombinant inbred lines for fibre strength (g/tex)

DHBR lines	Fibre strength (g/tex)	SCY (kg/ha)	Boll wt (g)	plant height (cm)	Monopodia /plant	Sympodia /plant	Bolls /plant	Seed index (g)	Lint index (g)	Ginning out turn (%)	2.5 % Span length (mm)	Uniformity ratio (%)	Maturity ratio	Micronaire value (µg/in)	Fibre elongation (%)
DHBR-31	24.66	574.84	4.02	100.38	1.89	17.66	9.59	10.12	4.76	31.39	29.67	47.45	0.63	3.63	6.03
DHBR-20	24.18	1313.78	4.07	92.39	1.67	15.41	11.13	9.41	5.44	36.46	28.32	49.14	0.70	3.68	5.88
DHBR-192	24.16	354.76	3.49	83.13	2.23	14.55	11.33	8.77	4.09	30.91	31.04	46.16	0.67	3.13	5.95
DHBR-146	24.14	344.05	2.90	84.73	1.98	17.34	18.12	9.79	3.89	28.05	28.34	47.20	0.64	3.53	5.71
DHBR-145	23.84	592.09	3.19	86.69	2.15	16.72	13.54	9.61	4.34	30.69	27.30	48.36	0.63	3.71	5.98
DHBR-199	23.74	516.69	3.26	85.64	2.08	21.74	8.94	9.21	4.07	27.70	28.41	47.04	0.64	3.42	5.70
DHBR-195	23.40	396.06	2.95	82.49	1.78	14.78	14.64	10.35	5.20	33.78	27.56	47.05	0.66	3.50	5.91
DHBR-93	23.20	634.80	3.56	75.34	1.66	15.29	13.27	7.65	3.29	29.23	27.36	48.09	0.65	3.31	5.76
DHBR-109	23.20	634.96	3.88	69.06	1.09	15.21	9.42	9.11	4.75	31.60	27.75	46.91	0.62	3.91	5.13
DS-28	20.75	853.56	4.55	77.48	1.53	14.89	9.71	8.50	5.33	37.99	26.58	46.70	0.64	3.80	5.49
SBFY-425	25.98	91.49	3.25	77.22	1.65	15.00	8.84	10.24	4.41	31.89	32.99	47.94	0.61	3.05	5.54
Sahana	21.52	1025.63	4.51	86.04	1.67	15.83	9.38	9.44	5.69	39.07	27.25	46.79	0.65	3.64	5.57
Surabhi	22.90	657.42	4.52	80.30	1.65	18.11	10.14	8.56	4.95	34.18	28.51	47.02	0.64	3.63	5.66
MCU-5	23.13	659.49	4.08	91.52	2.19	16.17	11.09	9.00	5.22	35.78	29.37	46.77	0.67	3.53	5.84
CD@5%	1.727	199.12	0.5	34.84	0.2	2.15	1.5	1.21	0.692	2.74	1.82	1.49	0.38	0.107	0.3
CV (%)	4.68	19.29	12.89	10.49	19.05	8.54	20.51	7.82	12.84	8.28	4.82	2.42	4.30	8.88	5.02

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CONCLUSION

Therefore, from this study confirms that, it is possible to generate and identification of superior recombinant inbred lines which are better than better parent and commercial check for many desirable traits like seed cotton yield, ginning out turn and fibre strength from the inter-specific (*G. hirsutum* X *G barbadense*) cross. Identified recombinant lines can be used as a variety after large scale testing. On other hand it was also possible to identify RILs with promising trait value for ginning out turn and fibre strength. They would be source of genetic materials in breeding program for incorporation in to high yielding genotypes.

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