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ASSOCIATION OF QUALITATIVE AND YIELD CONTRIBUTING TRAITS IN UPLAND COTTON

SUMMARY

Correlation of the qualitative traits like flower shape, boll colour and boll shape was analysed with the yield and fibre quality traits. Ten varieties were crossed. Parents along with hybrids were sown in field in the research area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Studies revealed that tubular flower shape showed negative association with green boll colour and ovate boll shape. Green boll colour had negative correlation with ovate boll shape. The qualitative traits like flower shape, boll shape and boll colour also act as markers for selection of polygenic traits like fibre quality and boll characteristics. Dark green boll colour showed positive association with plant height, number of bolls per plant, boll weight, number of locales and fibre strength. Green boll colour negatively correlated with tubular flower shape. Round boll shape had positive correlation with number of sympodial branches and boll weight. Ovate boll shape had negative association with fibre fineness and fibre strength. Tubular flower shape had negative association with plant height, number of sympodial branches, number of monopodial branches, number of bolls per plant, boll weight, and number of locules, GOT%, fibre fineness and fibre strength. Bell shape of flower had positive association with staple length. The association of quality with yield contributing traits may be helpful in future for the development of varieties.

Key words: Cotton, qualitative traits, fiber quality, correlation

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is the main fibre and industrial crop of Pakistan (Ahmed *et al*., 2008). For meeting the fiber demands of ever increasing world's population the major cotton producing countries have realized its importance. Similarly in Pakistan cotton research needs to be versatile and purpose oriented to develop more productive cotton cultivars that can adapt to various agro– ecological zones of the country (Salahuddin *et al*., 2010). For such

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a development plant breeder must know the association between yield components and fiber quality traits so that he may be able to develop high yielding cotton cultivars possessing better fiber quality to meet the needs of the farmer and textile industry. The association analysis provides a good index to predict the corresponding change which occurs in one character at the expanse of the proportionate change in the other. Meena *et al.* (2007) studied the stability and adaptation of cotton cultivars and found varied values for different agronomic, morphological and yield contributing traits.

In the last decade much progress has been made in evolving new cotton genotypes for high yield and better fibre quality. Like quantitative traits qualitative characters are also very important. The morphological markers like flower shape, boll colour, boll shape can also be used for the indication of yield and fibre quality. This will help to reduce the time and cost of the experiment. In the present research, the association of these morphological markers with yield and fibre quality traits was determined. Killi *et al*. (2005) reported that fibre fineness positively associated with seed cotton weight and negatively associated with a number of sympodial branches, number of mature bolls, plant height, fibre length and fibre strength. Ekinci *et al.* (2010) reported a positive correlation of number of monopodial branches with single boll weight, number of bolls per plant and number of sympodial branches. Feng *et al*. (2011) observed that fibre colour negatively correlated with lint percentage, fibre length, fibre elongation, fibre strength and fibre uniformity. The present studies will be helpful to draw useful conclusions regarding yield and quality traits.

MATERIAL AND METHODS

For the experiment, ten varieties were taken as parents. These parents were crossed during the winter of 2010-11 in Glasshouse for synthesizing their F_1 hybrids. These parents and their F_1 hybrids were sown in a field in the research area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad in normal crop season. The experiment was laid out in randomized complete block design with three replications. There was a single row for each of the parents and F_1 hybrids. Each row contained 10 plants. Row to row and plant to plant distance was 75cm and 30cm respectively.

The data were recorded for plant height, number of sympodial branches, number of monopodial branches, number of bolls per plant, boll weight, number of locules per boll, GOT %, fibre fineness, staple length, fibre strength, fibre uniformity, flower colour, flower shape, boll colour, boll shape.

Measurement of studied traits. When apical growth of the main stem had ceased, the final height of the five guarded plants was measured from the first cotyledonary node to apical bud in centimetres using measuring rod. The sympodial branches (direct fruit bearing branches) monopodia per plant (indirect fruiting branches) and bolls per plant were counted manually from five guarded plants from all three replications and then average was calculated. Similarly, number of locks per boll was counted from five guarded plants from each replication.

Boll shape was observed and recorded before the opening of bolls. Only two shapes were observed, ovate and round. In the collection of data and calculation of correlation, ovate shape was taken as 1 and round shape as 2. Boll color in cotton is the intensity of green color in bolls. For the estimation of the correlation, green color leaf was assigned as 1 and dark green as 2. The shape of the flower was observed and recorded when the blooming started. Flowers were of bell shape or tubular shape. In the collection of data and calculation of correlation, bell shaped flower was assigned as 1 and tubular shape as 2. Total seed cotton yield was weighed and ginned with a single roller electrical gin. The lint obtained from the sample was weighed. Ginning percentage was calculated by the following formula. The mean value for each genotype was calculated as follows:

$$\text{LP}~(\%) = \frac{\text{Weight of lint in a sample}}{\text{Weight of seed cotton in sample}} \times 100$$

Fiber characteristics, fibre length (SL), fiber fineness (FF), fiber strength (FS) and fiber uniformity (%) from the lint samples of the selected plants were also recorded by using Uster HVI-900 S.A., in the Department of Fiber Technology, University of Agriculture Faisalabad. The computerized instrument records fibre length (mm), fiber fineness (µg/ inch) and fiber strength (g/tex) according to the international standards. The collected data subjected to statistical analysis following the method outlined by Steel *et al*. (1997) and correlation coefficient calculated by the formula as proposed by Dewey and Lu (1959) using the Minitab program of a computer.

RESULTS AND DISCUSSION

The mean performance of the parents and crosses is given in table -1. According to the correlation matrix, plant height had positive and significant correlation with sympodial and monopodial branches, bolls per plant, boll weight, fibre strength and dark green boll color and negative correlation with GOT%, fibre fineness, staple length and tubular flower shape Table-2. Akbar *et al*. (1994) reported positive association of plant height with bolls per plant while Killi *et al*. (2005) observed a positive association of plant height with sympodial branches, bolls per plant, fibre length and fiber strength which are in conformity to the present findings.

The sympodial branches had positive and significant association with monopodial branches, bolls per plant, GOT%, fibre strength and round boll shape while it had a negative association with fibre fineness, staple length and tubular flower shape. Similar positive association of sympodia per plant with bolls per plant, lint percentage and fibre fineness were reported by Killi *et al*. (2005). Number of monopodial branches per plant had positive and significant correlation with bolls per plant and negative association with tubular flower shape. Usherett *et al*. (1999) and Ekinci *et al*. (2010) reported that number of monopodial branches had a positive association with bolls per plant which are in accordance with the present results. Murthy (1999) and Gite *et al*. (2006) found positive association of number of monopodial branches with lint yield.

Table 1. Means performance of the parents/crosses for various morphological and quality traits

Genotype	PH (cm)	SB	MB	NB	BW (g)	NL	GOT (%)	FF (µg/inch)	SL (mm)	FS (g/tex)	FU	SF	BC	BS
MNH-93	158.20	17.87	0.80	24.60	4.20	4.67	34.62	4.47	28.20	20.60	49.10	Bell	Dark Green	Round
SLS-1	123.13	18.00	1.00	26.40	3.30	4.00	35.29	4.43	27.03	18.83	46.13	Bell	Green	Ovate
CIM-240	122.93	24.07	0.60	24.60	4.27	4.67	36.45	4.60	27.43	18.47	48.00	Bell	Dark Green	Ovate
FH-901	148.67	19.80	0.87	26.80	4.03	4.00	36.36	4.93	27.13	19.73	45.97	Bell	Green	Round
Austin	99.20	14.40	0.33	25.40	3.63	4.33	34.52	4.13	28.93	18.83	46.43	Tubular	Dark Green	Round
CRIS-134	129.93	16.20	0.53	26.80	3.13	4.00	36.44	3.87	26.97	18.13	46.20	Bell	Dark Green	Round
VH-61	122.67	16.20	0.60	28.40	3.80	4.67	35.22	4.17	27.00	19.43	46.60	Bell	Green	Round
Braize	83.13	15.47	0.47	28.00	3.60	4.00	34.38	4.07	26.73	18.20	46.60	Tubular	Green	Round
BH-163	137.33	14.33	0.40	30.20	3.90	4.67	34.99	4.17	25.03	19.37	45.47	Bell	Dark Green	Round
NIAB-Karishma	131.53	20.53	0.60	28.40	3.43	4.00	36.51	4.07	24.97	19.63	44.53	Tubular	Green	Round
NIAB- Karishma×MNH-93	142.13	18.67	0.73	28.80	4.23	5.00	36.15	4.63	24.63	19.40	43.63	Bell	Dark Green	Round
NIAB-Karishma×CRIS-134	115.13	19.07	0.53	28.20	3.20	4.33	36.20	4.13	25.70	19.63	48.30	Bell	Dark Green	Round
NIAB-Karishma×BH-163	124.40	18.33	0.60	25.40	3.43	4.33	34.38	4.23	26.23	19.60	46.73	Bell	Dark Green	Round
NIAB-Karishma×Austin	108.13	15.80	0.40	25.20	3.37	4.00	34.69	4.23	26.50	17.97	45.80	Tubular	Dark Green	Round
NIAB-Karishma×SLS-1	123.47	20.93	1.07	25.40	3.30	4.00	34.35	4.43	26.93	20.33	47.20	Bell	Green	Round
NIAB-Karishma×VH-61	116.13	17.13	0.60	26.40	3.37	4.00	36.59	4.57	24.97	20.63	45.67	Bell	Green	Round
NIAB-Karishma×Braize	105.07	12.27	0.60	25.40	3.27	4.00	34.58	4.27	26.90	18.77	44.93	Tubular	Green	Round
CRIS-134×MNH-93	133.73	21.47	0.40	26.80	3.63	5.00	38.67	4.30	25.43	17.67	44.57	Bell	Dark Green	Round
CRIS-134×VH-61	134.00	14.93	0.87	30.80	3.60	4.00	36.77	4.47	25.47	20.83	47.23	Bell	Dark Green	Round
CRIS-134×BH-163	137.33	19.40	0.47	31.20	3.50	4.00	36.66	4.07	25.70	19.77	46.10	Bell	Dark Green	Round
CRIS-134×Austin	117.87	23.40	0.53	30.80	3.50	4.00	34.37	4.37	26.43	17.77	43.37	Bell	Dark Green	Round
CRIS-134×SLS-1	145.27	20.07	0.60	28.40	3.43	4.33	34.83	4.47	26.70	19.23	45.17	Bell	Dark Green	Round
CRIS-134×Braize	125.07	23.47	0.53	27.40	3.50	4.00	34.22	4.40	24.70	19.60	46.83	Tubular	Dark Green	Round
BH-163×MNH-93	122.53	20.93	0.87	27.40	3.57	4.67	36.82	3.97	26.53	17.43	46.73	Bell	Dark Green	Round
BH-163× SLS-1	160.67	22.20	0.73	28.40	3.40	4.00	37.50	4.00	28.07	19.30	46.70	Bell	Green	Round
BH-163×Austin	108.93	18.93	0.67	28.80	3.57	4.33	35.29	4.13	26.60	18.80	44.13	Tubular	Dark Green	Round
BH-163×VH-61	146.53	19.20	0.67	29.20	3.40	4.00	37.68	4.50	25.00	18.80	52.60	Bell	Dark Green	Round
BH-163×Braize	127.47	17.87	0.60	23.40	3.60	4.00	35.96	4.50	24.20	18.57	42.50	Tubular	Dark Green	Round
SLS-1×VH-61	154.27	16.80	0.60	25.40	3.40	4.00	36.67	4.63	26.00	17.83	46.90	Bell	Green	Round
SLS-1×Austin	123.47	16.00	0.87	24.80	3.37	4.00	34.39	4.60	24.90	17.27	46.03	Tubular	Dark Green	Round
SLS-1×Braize	128.93	14.07	0.53	22.20	3.60	4.00	34.26	4.53	24.43	17.73	45.77	Tubular	Green	Round
Austin×VH-61	131.93	19.87	0.67	28.40	3.50	4.00	37.36	4.53	27.40	19.20	44.40	Tubular	Dark Green	Round

List of traits along with abbreviations used: Plant height (PH, cm), No. of sympodial branches (SB), No. of monopodial branches (MB), No of bolls per plant (NB), Boll weight (BW, g), No of locules per boll (NL), GOT%, Fiber fineness (FF, µg/inch), Staple length (SL, mm), Fiber Strength (FS, g/tex), Fibre uniformity% (FU), Shape of flower (SF), Boll color (BC) and Boll shape (BS).

Table 2. Correlation matrix of different quality and yield contributing traits

	PH (cm)	SB	MB	NB	BW (g)	NL	GOT (%)	FF (µg/inch)	SL (mm)	FS (g/tex)	FU (%)	SF	BC
SB	0.26**												
MB	0.14**	0.48**											
NB	0.33**	0.30**	0.15**										
BW(g)	0.12**	-0.05^{NS}	0.04^{NS}	-0.06^{NS}									
NL	0.05^{NS}	-0.06^{NS}	0.03^{NS}	0.05^{NS}	0.34**								
GOT(%)	-0.12**	0.09*	0.06^{NS}	0.12**	0.05^{NS}	0.10*							
FF(µg/inch)	0.19**	0.37**	0.06^{NS}	0.02^{NS}	-0.012^{NS}	-0.12**	-0.15**						
SL(mm)	-0.09*	-0.23**	0.02^{NS}	-0.07^{NS}	0.30**	0.07^{NS}	-0.07^{NS}	-0.23**					
FS (g/tex)	0.19**	0.12**	0.08^{NS}	0.06^{NS}	0.08^{NS}	0.06^{NS}	0.04^{NS}	0.08^{NS}	-0.06^{NS}				
FU(%)	0.08^{NS}	0.08^{NS}	-0.07^{NS}	0.15**	0.18**	0.20**	-0.03^{NS}	0.12**	-0.01^{NS}	0.09*			
SF	-0.23**	-0.12**	-0.09*	-0.16**	-0.13**	-0.12**	-0.26**	0.09*	0.15**	-0.12**	-0.12**		
BC	0.29**	-0.07^{NS}	0.08^{NS}	0.20**	0.17**	0.22**	0.08^{NS}	-0.04^{NS}	-0.05^{NS}	0.09*	0.04^{NS}	-0.33**	
BS	-0.03^{NS}	0.20**	0.04^{NS}	0.01^{NS}	0.22**	-0.06^{NS}	-0.05^{NS}	0.12**	-0.006^{NS}	-0.17**	0.01^{NS}	-0.12**	-0.16**

However, Rauf *et al*. (2004) found positive association of monopodia per plant with plant height and boll weight while with sympodia and bolls per plant they found negative correlations. Iqbal *et al*. (2006) revealed positive association of monopodial branches with sympodial branches, bolls per plant and lint yield. Number of bolls per plant had a positive and significant association with GOT%, fibre uniformity and dark green boll color while it had a negative association with tubular flower shape. Gite *et al*. (2006) and Salahuddin *et al*. (2010) determined positive correlation of bolls per plant with lint yield. Thiyagu *et al*. (2010) observed negative association of bolls per plant with boll weight which is in agreement with the current findings, but with GOT% they observed contrasting results.

Boll weight had positive correlation with number of locules per boll, staple length, fibre uniformity, dark green boll color and round boll shape while it showed negative correlation with tubular flower shape. Khan *et al*. (1980) and Rasheed *et al*. (2009) reported positive association between boll weight and fibre length. Iqbal *et al*. (2006) determined correlation among different traits in cotton and found that boll weight negatively correlated with number of bolls per plant which is in support of present results. But Rasheed *et al*. (2009) observed positive correlation of boll weight with a number of bolls per plant. A number of locules had positive correlation with GOT%, fibre uniformity, fibre fineness and dark green boll color while it had negative correlation with tubular flower shape.

It suggests that the plant with bolls having more number of locules will have more GOT%, fibre uniformity and fibre fineness. Singh *et al*. (1968) observed positive association of number of locules per boll with yield in cotton. GOT% had a significant positive association with fibre fineness and negative association with tubular flower shape. It suggests that increase in GOT% will also increase the fibre fineness. Hussain *et al*. (2010) determined correlation among various traits and found negative association with of GOT% with fibre fineness which are contradictory to the present results. Ahmad and Azhar (2000) also reported positive association of GOT% with bolls per plant, boll weight and staple length which are also in disagreement to the present results. The fibre fineness had positive correlation with staple length and negative correlation with fibre uniformity, tubular flower shape and ovate boll shape. It suggests that an increase in fibre fineness will also increase the staple length but decrease the fibre uniformity. Desalegn *et al*. (2009) determined positive association with staple length and negative association with fibre uniformity. Karademir *et al*. (2010) observed negative association of fibre fineness with fibre uniformity. However, Killi *et al*. (2005) studied correlation and found negative association of fiber strength with sympodial branches, number of mature bolls, plant height, fibre length and fibre strength. The difference may be due to the variation in cultivars.

Staple length positively correlated with bell flower shape but negatively correlated with fiber strength and uniformity. Azhar *et al*. (2004) observed negative association of staple length with fibre fineness. However, Larik *et al*. (1999) and Karademir *et al*. (2010) concluded that staple length had positive correlation with fibre strength. Fibre strength had a positive association with fibre uniformity and dark green boll color and negative association with tubular flower shape and ovate boll shape. It suggests that the fibre having more strength may increase fibre uniformity. Killi *et al*. (2005) and Karademir *et al*. (2010) reported that fibre strength positively associated with plant height, and fibre uniformity. However, Desalegn *et al*. (2009) observed negative association of fiber strength with fibre uniformity. Tubular flower shape showed a negative association with green boll color and ovate boll shape. Green boll color had negative correlation with ovate boll shape. The qualitative traits like flower shape, boll shape and boll color also act as markers for selection of polygenic traits like fibre quality and boll characteristics.

CONCLUSIONS

It is concluded from the above discussion that the bell shaped flower is the indicator of increased number of bolls per plant, boll weight, fibre with more strength, length and uniformity. The tubular flower shape indicates fine fibre. Dark green boll color indicates the number of bolls, increased boll weight and more fibre strength. Ovate boll shape indicates less fine fibre. Round boll shape is the marker of increased boll weight but less fibre strength. These studies may be helpful in designing varietal development programme as various desirable significant correlations and conclusions obtained from the current studies which may be exploited to develop new strains. Random matting among genotypes could be a good technique to break negative association among genes.

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VEZA IZMEĐU KVALITATIVNIH OSOBINA I OSOBINA KOJE DOPRINOSE PRINOSU KOD KOMERCIJALNOG AMERIČKOG PAMUKA

SAŽETAK

Izvršena je analiza korelacije između kvalitativnih osobina, kao što su oblik cvijeta, boja i oblik čaure, sa osobinama prinosa i kvaliteta vlakna. Ukršteno je deset sorti. Matične sorte su, zajedno sa hibridima, posijani na poljima u okviru posmatranog područja Katedre za oplemenjivanje bilja i genetiku, Poljoprivrednog fakulteta, Faisalabad. Istraživanja su pokazala da cjevasti oblik cvijeta ima negativnu povezanost sa zelenom bojom čaure i ovalnim oblikom čaure. Zelena boja čaure ima negativnu korelaciju sa ovalnim oblikom čaure. Kvalitativne osobine kao što su oblik cvijeta, oblik čaure i boja čaure, takođe imaju ulogu markera u odabiru poligenih osobina, kao što su kvalitet vlakna i karakteristike čaure. Tamno-zelena boja čaure pokazuje pozitivnu povezanost sa visinom biljke, brojem čaura na biljci, težinom čaure, brojem lokula i jačinom vlakna. Zelena boja čaure ima negativnu korelaciju sa cjevastim oblikom cvijeta. Okrugli oblik čaure ima pozitivnu korelaciju sa brojem simpodijalnih grana i težinom čaure. Ovalni oblik čaure ima negativnu povezanost sa finoćom vlakna i jačinom vlakna. Cjevasti oblik cvijeta ima negativnu povezanost sa visinom biljke, brojem simpodijalnih grana, brojem monopodijalnih grana, brojem čaura po biljci, težinom čaure, brojem lokula, GOT%, finoćom vlakna i jačinom vlakna. Zvonasti oblik cvijeta ima pozitivnu povezanost sa dužinom prediva. Povezanost između osobina koje doprinose prinosu može biti od koristi za razvoj sorti u budućnosti.

Ključne riječi: pamuk, kvalitativne osobine, kvalitet vlakna, korelacija