Pak. J. Bot., 41(4): 1695-1705, 2009.

GENETIC VARIABILITY AND HERITABILITY IN UPLAND COTTON

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Abstract

The research work comprising of genetic variability, heritability and correlation study for seed cotton yield and its components in cotton (*Gossypium hirsutum* L.) cultivars was carried out during 2005 at the NWFP Agricultural University Peshawar, Pakistan. Cultivars mean values manifested highly significant differences for all the traits except locules boll^{-1}. Genetic potential of cultivars for different parameters revealed plant height (137.30 to 155.30 cm), bolls sympodia^{-1} (2.28 to 3.31), bolls plant^{-1} (14.00 to 25.95), boll weight (3.07 to 4.16 g), locules boll^{-1} (4.30 to 4.48) and seed cotton yield (1200 to 2450 kg ha^{-1}). Genetic variances were found almost greater than the environmental variances for all the traits except bolls sympodia^{-1} and locules boll^{-1}. High broad sense heritability (H^2) and genetic gain were recorded for plant height (0.94, 9.41 cm), bolls sympodia^{-1} (0.81, 0.44), bolls plant^{-1} (0.96, 6.63), boll weight (0.96, 0.64 g) and seed cotton yield (0.98, 643.16 kg), respectively. Correlation of seed cotton yield with other different traits was found significantly positive for majority of traits i.e., plant height (r = 0.560), bolls sympodia^{-1} (r = 0.158), bolls plant^{-1} (r = 0.820) and boll weight (r = 0.476). This type of correlation is desirable by cotton breeders and little genetic gain in bolls per plant, boll weight and bolls per sympodia is a great accomplishment. Cultivars CIM-499 CIM-473, CIM-496 and CIM-506 have larger genetic potential and room for enhancement of seed cotton yield and its attributes under the prevailing environmental conditions of Peshawar, Pakistan.

Introduction

Excavations of Mohen Jo Daro, Pakistan showed that the cotton was cultivated in Sindh, Pakistan before 2500 B.C. (Khan, 2003). Cotton growing area in NWFP province is now mainly confined to the extreme southern regions. About five decades ago, cotton was also grown in Peshawar valley and Bannu and their surrounding areas called “Pumba”, but now concentrated only to the plain areas of D.I.Khan. From the last two decades, Punjab and Sindh provinces of Pakistan are already under pressure of insect pests and Cotton Leaf Curl Virus (CLCuV). Therefore, there is a tremendous scope of cotton cultivation in the new areas of NWFP and Balochistan provinces which can help in boosting the crop yield horizontally as well as vertically (Khan, 2003; Ahmad *et al*., 2008).

Cotton is of great economic importance and the textile industry occupies the prominent position in Pakistan. Hence, our economy and market channels are oriented in such way that wide vicissitudes in cotton production pose significant threat of economic difficulty. Consequently, continuous sufficient production of cotton has not only become imperative but we must find out the ways to obtain maximum yield per unit area because we are not in position to allocate more land for cotton production at the expense of other crops. During 2006-07, the cotton crop was grown on 3.075 million hectares and seed cotton production was 12.856 million bales with average seed cotton yield of 711 kg ha^{-1} (Anon., 2007). The declining trend has been contained with the efforts of plant breeders, however, more efforts are required for increased and sustainable cotton production.

Afiah & Ghoneim (2000), Khan (2003) and Ahmad *et al*., (2008) after evaluating genetically diverse genotypes for yield and its components reported highly significant correlation which indicated that any improvement in yield component as boll weight would have a positive effect on seed cotton yield. Iqbal *et al*., (2003) and Wang *et al*., (2004) revealed that genotypic correlation was higher than the corresponding phenotypic correlation for all parameters studied. Seed cotton yield per plant was significantly and positively correlated with boll weight and bolls per plant. Rao & Mary (1996) and Meena *et al*., (2007) also evaluated different upland cotton cultivars for yield and other economic characters and observed significant variations for yield contributing traits and showed positive effect on seed cotton yield. Arshad *et al*., (1993) and Soomro *et al*., (2008) also summarized positive correlation of yield with yield components including bolls per sympodia and sympodia per plant in upland cotton.

Consequently, the identification and use of genotypes with better genetic potential is a continuous prerequisite for synthesis of physiologically efficient and genetically superior genotypes showing promise for increased production per unit area under a given set of environments. To achieve these objectives, a comprehensive study of the genetic mechanism of the control of plant characters under different environmental conditions is also an obligation. In view of the pivotal importance of cotton in the national economy, the current research programme was initiated to study the genetic variability and potential of different upland cotton cultivars for yield and its attributes. Heritability, genetic, environmental and phenotypic variances, expected response to selection and the association of seed cotton yield with morphological and yield traits was also studied.

Materials and Methods

Plant material and experimental design: The research work pertaining to study of genetic variability and potential of cotton cultivars, heritability (H^2), genetic advance and correlation of seed cotton yield with other traits in upland cotton cultivars was conducted during 2005 under the prevailing environmental conditions at NWFP Agricultural University, Peshawar, Pakistan. Peshawar lies between 34°, 02′ North latitude and 71°, 37′ East longitude. Breeding material comprised of 8 different *Gossypium hirsutum* genotypes having broad genetic base and varied by date of release, pedigree, seed cotton and fiber yield as well as fiber and oil quality traits. The cultivars were CIM-466, CIM-473, CIM-496, CIM-499, CIM-506, CIM-538, CIM-707 and SLH-279. All the cultivars were hand sown during mid of May, 2005 with intra- and inter-row spacing of 30 and 75 cm, respectively in a randomized complete block (RCB) design with four replications. Thinning was performed twice after 15 and 25 days of germination when the plant height was 10 and 20 cm, respectively to ensure single plant per hill. Each sub-plot of a cultivar was having four rows with eight m length. All the recommended cultural practices and inputs including fertilizer, hoeing, irrigation and pest control were applied same for all the entries from sowing till the harvesting and the crop was grown under uniform conditions to minimize environmental variability to the maximum possible extent. Picking was made during the months of November-December on single plant basis and ginning was done with eight saw-gins.

Traits measurement and statistical analyses: The data were recorded on individual plant basis before average for the following parameters i.e., plant height (cm), bolls per sympodia, bolls per plant, boll weight (g), locules per boll and seed cotton yield (kg ha^{-1}).

All the recorded data were subjected to analysis of variance (ANOVA) technique for a RCB design as outlined by Steel & Torrie (1980) through Mstatc computer programme for all the traits to test the null hypothesis of no differences among the cotton genotypes. The genotypes means for each parameter were further separated and compared by using the least significant difference (LSD) test at 5% level of probability. For each trait the genetic, environmental and phenotypic variances, broad sense heritability (H^2) and expected response to selection (Re) were further estimated from the ANOVA mean squares according to Burton (1951) as given below. The simple correlation coefficient (r) of seed cotton yield with other yield components was also worked out according to Kwon & Torrie (1964).

$$\text{Genetic variance (Vg)} = \frac{\text{Genotypes mean squares (GMS)} - \text{Error mean squares (EMS)}}{\text{Number of replication (r)}}$$

$$\text{Environmental variance (Ve)} = \text{Error means squares (EMS)}$$

$$\text{Phenotypic variance (Vp)} = \text{Vg} + (\text{Ve}/\text{r})$$

Heritability (H^2) on entry mean basis was calculated as:

$$H^2 = \frac{Vg}{Vp}$$

The expected response to selection (Re) for each trait was calculated as under:

$$\text{Re} = k\sqrt{vp}\,H^2$$

where:

k = 1.40 at 20% selection intensity for a trait
vp = Phenotypic variance for a trait
H^2 = Broad sense heritability for a trait

Results and Discussion

According to analysis of variance (Table 1), the mean values for 8 cotton genotypes manifested highly significant differences ($p \leq 0.01$) for plant height, bolls per sympodia, bolls per plant, boll weight and seed cotton yield, while the means showed non-significant differences for the trait locules per boll.

Plant height: Overall plant height ranged from 137.30 to 155.30 cm among 8 genotypes (Fig. 1). The highest plant height was observed in CIM-499 (155.30 cm) followed by CIM-538 (150.00 cm), CIM-506 (148.80 cm), CIM-496 (148.30 cm) and CIM-707 (148.00 cm). Minimum and statistically at par plant height was observed in SLH-279 and CIM-446 ranged from 137.30 to 138.30 cm, respectively. Plant height is positively correlated with seed cotton yield if lodging didn't occur. Genetic and environmental variances were 48.27 and 9.93, respectively (Table 2). Genetic variances were five times greater than environmental variances. The heritability (H^2) estimation was 0.94 and the expected response to selection for plant height was 9.41 cm, using 20% selection intensity. Correlation was positive and highly significant (r = 0.560) for the said trait with seed cotton yield (Table 3).

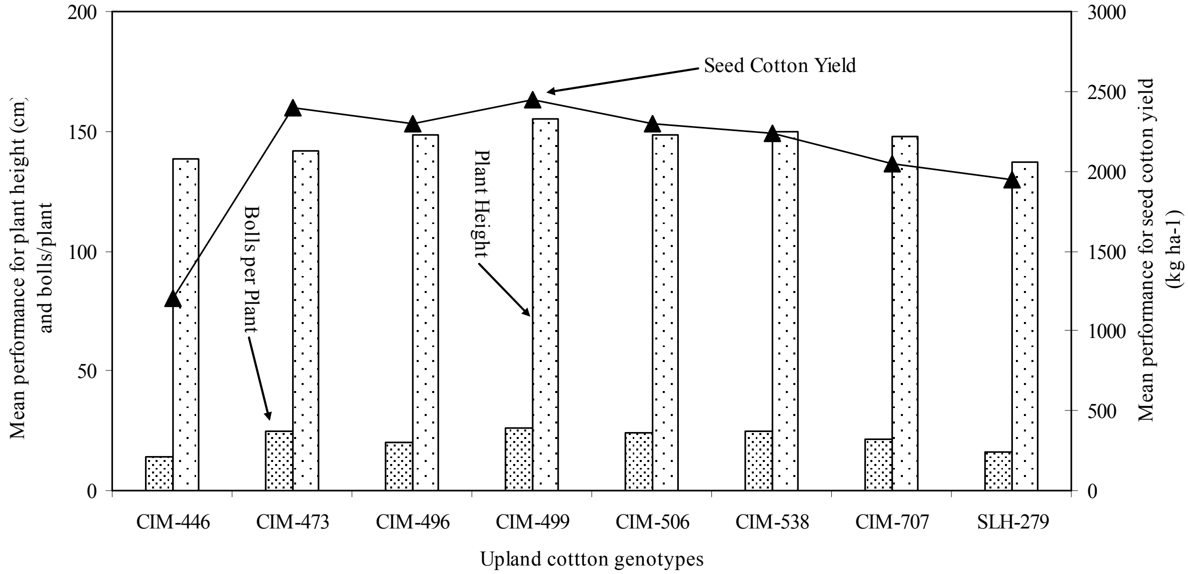

Fig. 1. Mean performance for plant height, bolls per plant and seed cotton yield in upland cotton.

Table 1. Mean squares for various traits of upland cotton.

Parameters	Mean squares		F. Ratio	CV %
	Genotypes	Error		
Plant height	154.75	9.93	15.59**	2.16
Bolls per sympodia	0.449	0.084	5.34**	10.66
Bolls per plant	72.58	2.72	26.71**	7.79
Boll weight	0.68	0.03	22.78**	4.78
Locules per boll	0.016	0.023	0.68 N.S.	3.48
Seed cotton yield	654542.41	10792.41	60.65**	4.92

** = Significant at p≤0.01, N.S. = Non-significant.

Table 2. Genetic, environmental and phonotypic variances and heritability with selection response for various traits of upland cotton.

Parameters	Vg	Ve	Vp	H^2	Re
Plant height	48.27	9.93	51.58	0.94	9.41 cm
Bolls per sympodia	0.12	0.084	0.15	0.81	0.44
Bolls per plant	23.29	2.72	24.19	0.96	6.63
Boll weight	0.22	0.03	0.23	0.96	0.64 g
Seed cotton yield	214583.33	10792.41	218180.80	0.98	643.16 kg

Vg=Genetic variance, Ve=Environmental variance, Vp=Phonotypic variance, H^2= Heritability broad sense, Re = Selection response

Table 3. Correlation of seed cotton yield with various traits of upland cotton.

Parameters	Correlation (r)	Std. Error
	Seed cotton yield	
Plant height	0.560**	8.497
Bolls per sympodia	0.158	176.963
Bolls per plant	0.820**	9.633
Boll weight	0.476**	151.215
Locules per boll	-0.228	425.997

** = Significant at p≤0.01

Plant height is very important trait and has close association with bolls per plant (if no lodging occurred) and has ultimate positive effect on seed cotton yield. Almost all the cultivars showed medium plant height with significant mean differences except two cultivars SLH-279 and CIM-446, which showed least plant height. Both cultivars SLH-279 and CIM-446 also confirmed the above hypothesis by having least number of bolls per plant. Taller cultivars (CIM-499, CIM-538, CIM-506 and CIM-496) showed medium to high number of bolls per plant. Results revealed that the trait boll per plant which is a varietal trait and not entirely dependent on plant height, but plant height contribution can not be ignored also. High H^2 with expected response to selection also revealed that the genetic variances play important role in inheritance and establishment of the said trait. The correlation of the said trait was also found positive and highly significant with seed cotton yield.

Plant breeders are generally interested in short stature plants due to lodging threat, and found also easy in picking as manual or by machine. But plant height was found positively correlated with boll number and seed cotton yield (Khan *et al*., 2003). However, Chen *et al.,* (1991) studies revealed that in *G. hirsutum* cultivars, the plant height and sympodia were significantly correlated with each other, and negatively correlated with first picking. There was genetic variability for plant height among different cotton cultivars and that plant height was positively correlated with bolls per plant and seed cotton yield if lodging didn't occur. Khan (2003), Taohua & Haipeng (2006), Meena *et al*., (2007) and Ahmad *et al*., (2008) studied the stability and adaptability of *G. hirsutum* cultivars and observed varied values for plant height and other yield components. Chen & Zhao (1991) studied plant height and plant type characteristics and found closely correlated with yield attributes. The plant type characteristics played an important role in the correlation with plant height and sympodia and concluded that attention should be paid to the selection of plant type characteristics in breeding. Arshad *et al.,* (1993) also evaluated upland cultivars and concluded that plant height was positively correlated with yield and boll number. Tyagi (1994a & b) and Murthy (1999) observed positive correlation between plant height and yield and their studies further revealed that the plant height contributed 70% of the total variability for seed cotton yield. Therefore, it is concluded that in cotton crop, plant height is desirable if no lodging occurred. The contradictory views of past researchers about the said trait might be due to genotypic and environmental variations and may be due to different genetic background of the breeding material used under various environmental conditions.

Bolls per sympodia: Bolls per sympodia ranged from 2.28 to 3.31 among all the genotypes (Fig. 2). Highest bolls per sympodia were observed in CIM-499 (3.31) and were found statistically at par with CIM-473 (2.90). These cultivars were followed by CIM-506, CIM-446, CIM-538, CIM-446 and SLH-479 ranged from 2.48 to 2.83. The lowest bolls per sympodia (2.28) were observed in cultivar CIM-707. Results revealed that bolls per sympodia has positive correlation with seed cotton yield, therefore the cultivars having maximum number of bolls per sympodia also showed increased seed cotton yield. Genetic and environmental variances for bolls per sympodia were 0.12 and 0.084, respectively (Table 2). H^2 was of greater magnitude (0.81) and the expected response to selection was 0.44 for the number of bolls per sympodia. Positive correlation (r = 0.158) was also recorded for the said trait with seed cotton yield (Table 3).

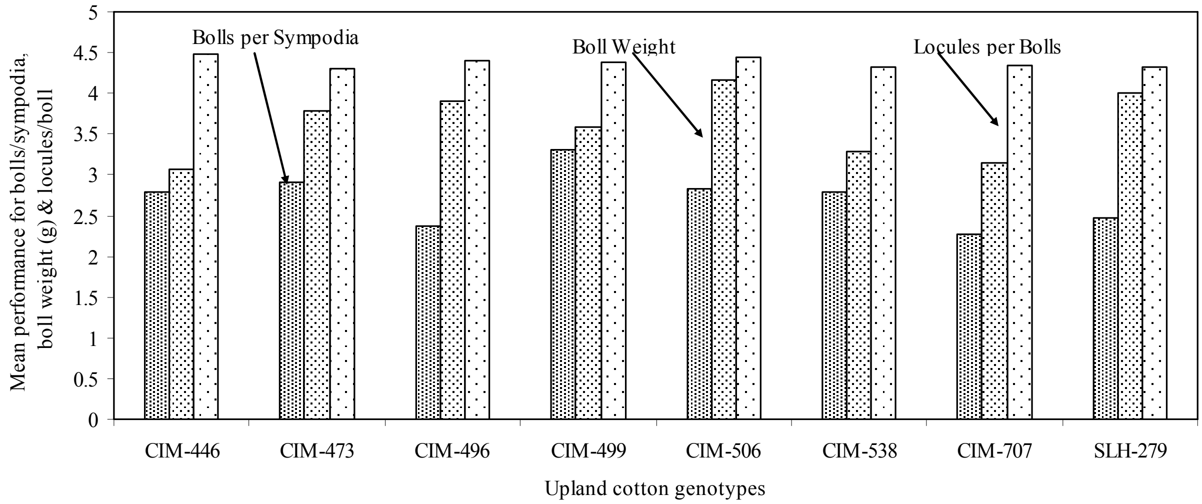

Fig. 2. Mean performance for bolls per sympodia, boll weight and locules per boll in upland cotton.

Morphological trait like sympodia plays an important role in cotton crop and those fruiting branches which bear cotton bolls also manage the bolls number and seed cotton yield in cotton plant. Both traits sympodia and bolls per sympodia were found mostly positively correlated with seed cotton yield. Highest bolls per sympodia were observed in CIM-499 and were found at par with CIM-473 and same positions followed in bolls per plant and seed cotton yield. Therefore, the cultivars having maximum number of bolls per sympodia also showed increased seed cotton yield. This said trait has a significant impact on the seed cotton yield, and the breeders should think about sympodia while breeding for seed cotton yield. In presence of highest heritability and expected response to selection, and positive correlation with seed cotton yield revealed that bolls per sympodia were mostly administered by genetic variances and there is a span for improvement in the said trait.

Murthy (1999) and Afiah & Ghoneim (2000) worked out that all the yield traits showed either significant positive association with bolls per sympodia and plant, as bolls per plant has direct effect from bolls per sympodia. Arshad *et al*. (1993) also summarized positive correlation of seed cotton yield with six yield components including bolls per sympodia and sympodia per plant in *G. hirsutum* cultivars. The same genetic variability and correlation for bolls per sympodia was also authenticated by Terziev *et al*. (1996). Chen & Zhao (1991) and Badr (2003) studied the effect of agronomic characteristics on seed cotton yield and correlation among plant type characteristics. Plant type traits as sympodia were primarily correlated with yield contributing traits. Sultan *et al.,* (1999), Iqbal *et al*., (2003) and Wang *et al*., (2004) also evaluated upland cotton cultivars and observed positive correlation of bolls per sympodia with yield. The current studies also revealed that there were an antagonistic association between boll number and boll weight and also had strong direct effect on seed cotton yield and lint yield. Therefore, it is concluded that attention should be paid to the selection of plant type characteristics in cotton breeding.

Bolls per plant: Bolls per plant picked in two pickings ranged from 14.00 to 25.95 (Fig. 1) among all the eight genotypes. Maximum bolls per plant were picked from CIM-499 (25.95) and were found statistically at par with CIM-473, CIM-538 having 25.00 and CIM-506 (24.00) bolls per plant. The lowest and at par bolls per plant were recorded in the cultivars CIM-446 (14.00) and SLH-279 (16.00). Bolls per plant have also a direct influence on seed cotton yield being their positive correlation. Genetic variance was 23.29, while the environmental variance was 2.72 (Table 2). Thus the genetic variance was eight times greater than the environmental variance. The H^2 for said trait was of greater magnitude (0.96) and using 20% selection intensity, the expected response to selection for bolls per plant was 6.63. Positive and highly significant correlation (r=0.820) was observed for the said trait with seed cotton yield (Table 3).

Bolls per plant is the major independent yield component that plays principal role in managing seed cotton yield. CIM-499, CIM-473 and CIM-538 by having larger number of bolls have also enunciated maximum plant height as discussed before. Bolls per plant have a direct influence on the yield and positively correlated with seed cotton yield. Thus the variability for said trait among different cultivars is a good sign and selection in the breeding material for high boll number will have a significant effect on the seed cotton yield. Cook & El-Zik (1993) authenticated that cotton cultivars differed significantly for boll production. The results were also in accordance with the findings of Khan (2003) who also reported variable number of bolls per plant. The heritability was of greater magnitude with expected response to selection, along with positive correlation with yield, exhibited that major portion of the said trait was controlled by genetic variance and played a crucial role.

Taohua & Haipeng (2006), Meena *et al*., (2007) and Ahmad *et al*., (2008) also evaluated the *G. hirsutum* cultivars and observed varied values for bolls per plant. Soomro *et al*., (2005) compared the yield and yield components of commercial cotton cultivars (CRIS-5A, CRIS-134, CRIS-9, CIM-496, CIM-499 and CIM-506) and observed significant differences for bolls per plant, yield and other yield attributes. Rao & Mary (1996) evaluated different *hirsutum* cultivars for yield and other economic traits and observed significant variations for bolls number and showed positive effect on yield. Murthy (1999), Sultan *et al.,* (1999) and Soomro *et al*., (2008) enunciated the positive genotypic correlation of bolls per plant with yield. Degui *et al*., (2003) also revealed the effects of genetic transformation on the yield and bolls per plant of cotton cultivars. The higher lint yields of cotton cultivars were mainly caused by higher number of bolls per plant and lint %. Iqbal *et al*., (2003) noted a positive association between stability variance for yield and the estimate of genotypic component for boll set indicated that boll set was the main contributor towards increase in seed cotton yield. Results also revealed that bolls per plant should receive greater emphasis in cotton improvement programmes as it contributes significantly. Therefore selection should be made for larger number of bolls per plant and high lint percentage for breeding cotton with high seed cotton and lint yields.

Boll weight: Boll weight was recorded from 3.07 to 4.16 g among the mean values revealed by all the genotypes (Fig. 2). The highest boll weight was observed in cultivar CIM-506 (4.16 g) and also found statistically at par with SLH-279 (4.00 g). These two cultivars were further followed by CIM-496 and CIM-473 with boll weight of 3.90 g and 3.79 g, respectively. Minimum and at par boll weight was manifested by cultivars CIM-446, CIM-707 and CIM-538 ranged from 3.07 to 3.29 g. Genetic and environmental variances for boll weight were 0.22 to 0.03, respectively (Table 2). Thus genetic variance was 700 times greater in magnitude compared to environmental variance. The heritability (H^2) approximation for boll weight was 0.96, while the genetic gain was 0.64 g under 20% selection intensity. Positive and highly significant correlation (r = 0.476) was observed for the said trait with seed cotton yield (Table 3).

Boll weight is second major yield component after bolls per plant and have a greater contribution in enhancement of seed cotton yield. By having bigger bolls, the cultivar CIM-506 was also proved to be in the list of top promising genotypes followed by SLH-279 with the same criteria. The least boll weight holder cultivar (CIM-446) also produced low seed cotton yield, as boll weight has direct association with seed cotton yield after bolls per plant. Therefore, it is concluded that boll weight is an important yield component and should be kept in mind while breeding for seed cotton yield. The H^2 estimate was high for the boll weight with desirable selection response and significant positive correlation, displaying that the said genotypes have the genetic potential to increase the boll weight.

Ivanova & stovanova (1996), Terziev *et al*., (1996) and Ahmad *et al*., (2008) also obtained similar proportions for boll weight in relation to seed cotton yield in different cotton cultivars. Taohua & Haipeng (2006) and Meena *et al*., (2007) studied the performance of cotton cultivars and observed varied values for boll weight. Rao & Mary (1996) also evaluated different *G. hirsutum* cultivars for yield and other economic characters and observed significant variations for boll weight and showed positive effect on yield. Afiah & Ghoneim (2000), Khan (2003) and Soomro *et al*., (2008) evaluated genetically diverse genotypes for yield and its components and reported highly significant correlation coefficient which indicated that any improvement in boll weight would have a positive effect on yield. Iqbal *et al*., (2003) and Wang *et al*., (2004) represent that genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients for all parameters studied. Seed cotton yield was significantly and positively correlated with boll weight and bolls per plant. The current results also revealed that the bolls number followed by boll weight have positive effect on yield.

Locules per boll: Mean values revealed that the genotypes were having nonsignificant differences for locules per boll (Fig. 2). However, average locules per boll noticed in different eight upland cotton genotypes were 4.30 (CIM-473) to 4.48 (CIM-446). Numerically, the highest number of locules per boll was recorded in CIM-446, CIM-506 and CIM-496 ranged from 4.40 to 4.48. The lowest locules per boll were recorded in CIM-473 (4.30), CIM-538 (4.33) and SLH-279 (4.20). Locules per boll have direct effect and correlation with seed cotton yield, so the cultivars having more number of locules per boll have higher seed cotton yield. Due to non-significant mean differences, the environmental variances played important role and were found greater than genetic variances, so the heritability and selection response could not be computed as well. The correlation of the said trait with seed cotton yield was also negative, but was non-significant which may also be due to non-significant mean differences (Table 3).

Morphological traits as locules per boll have also same effect on seed cotton yield as other yield components. The locules per bolls as like sympodia per plant have indirect effect on seed cotton yield. However, CIM-446 showed highest number of locules per boll, but was not high yielder as number of bolls were not in good response. Cultivars CIM-499, CIM-473, CIM-496 and CIM-506 have medium number of locules per boll but were high yielder as bolls number and boll weight played important role in these cultivars. Tyagi (1994a & b) and Ahmad *et al*., (2008) also mentioned the association of different morphological and yield traits and observed that locules per boll were significantly negatively associated with seed cotton yield. However, Khan (2003) and Ahmad *et al*., (2008) mentioned in their studies that some morphological and yield traits also varied significantly between cultivars and has close association with seed cotton yield. Chen & Zhao (1991) studied plant type and morphological traits and found closely correlated with yield components. The plant type characteristics played an important role and attention should be paid to the selection of plant type characteristics during breeding. The contradictory findings and different views of past researchers about the said trait might be due to genotypic and environmental variances and due to different genetic background of the cultivars used in various environmental conditions.

Seed cotton yield: Overall seed cotton yield in 8 cultivars ranged from 1200 to 2450 kg ha^{-1} (Fig. 1). Maximum and statistically at par seed cotton yield was observed in CIM-499 (2450 kg ha^{-1}) and CIM-473 (2400 kg ha^{-1}). These cultivars were found also at par with two other cultivars CIM-506 and CIM-496 with yield of 2300 kg ha^{-1}, followed by CIM-538 (2238 kg ha^{-1}). Lowest seed cotton yield was gained in CIM-446 (1200 kg ha^{-1}). The cultivars having more bolls number like CIM-499 and CIM-473 have also shown maximum seed cotton yield as both traits have a strong positive correlation. Genetic and environmental variances were 214583.33 and 10792.41, respectively and it observed that genetic variance was 20 times greater than environmental variance (Table 2). Consequently, the H^2 estimate for seed cotton yield was 0.98. The resultant expected selection response under selection intensity for seed cotton yield was 643.16 kg.

Seed cotton yield is an ultimate goal in growing cotton besides lint %. Highest seed cotton yield was observed in cultivars CIM-499 and CIM-473 and were also found the 2nd and 3rd top scoring genotypes for lint percentage. This type of correlation is rarely found and desirable by cotton breeders. Cultivars CIM-499, CIM-473, CIM-506 and CIM-496 have maximum seed cotton yield also manifested more bolls per plant and confirmed the strong correlation. Same genetic variability for seed cotton yield was reported by Cook & El-Zik (1993), Ivanova & stoynova (1996), Terziev *et al*., (1996) and Khan (2003). Genetic variances were found greater than environmental variances; hence, the H^2 estimation was high with desired genetic gain from selection. It revealed that yield was mainly controlled by genetic variance and there is an opportunity in the said genotypes for further enhancement in seed cotton yield.

Copur (2006) determined the yield and yield attributes of *G. hirsutum* cultivars and observed significant mean differences. Soomro *et al*. (2005) studied the yield in upland cotton and found that cultivars were at par for cotton yield of second pick at 120 days after planting (DAP). However, the cultivars showed significant differences for yield of first pick at 90 DAP, and third pick at 150 DAP, which further authenticated that the decision should be made about cultivars after completing all picks. Ahmad *et al*., (2008) also evaluated different *G. hirsutum* cultivars for yield and other economic characters and observed significant variations for bolls per plant and boll weight and their positive effect on yield. Khan (2003) reported significant correlation, which indicated that any improvement in boll weight would have a positive effect on yield. Soomro *et al*., (2005) and Ahmad *et al*., (2008) evaluated some strains of *G. hirsutum* and mentioned positive association between variances for yield and boll set, which indicated that boll set is the main contributor to seed cotton yield. Afiah & Ghoneim (2000), Badr (2003) and Soomro *et al*., (2008) mentioned that yield was highly and positively correlated with sympodia, bolls per plant and boll weight. The results obtained also revealed that seed cotton yield was the major contributor to lint yield and in turn the lint yield was found also the key donor to yield and was followed by lint % and boll weight. However, other traits were considered and found to have minor contributions to yield variance.

Conclusion

Success in cotton breeding is predominantly based on the selection and use of promising genotypes for hybridization, followed by assortment for favourable genes and gene complexes. The information regarding genetic variability and potential of genotypes, heritability and correlation in desirable traits provides reliable basis for the crop improvement. On the basis of the above studies, it is concluded that the cultivars CIM-499 CIM-473, CIM-496 and CIM-506 have larger genetic potential and space for further enhancement of seed cotton yield and its attributes. So for tangible results in yield and yield contributing traits, due consideration may be given to the above genotypes in the future cotton breeding programmes under environmental conditions of Peshawar, Pakistan.

Acknowledgments

The authors wish to thank Dr. Muhammad Arshad, Director Central Cotton Research Institute (CCRI) Multan, Pakistan for his untiring guidance and help, and to provide free of cost cottonseed, and the full facilities of ginning and testing of fiber quality traits.

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(Received for publication 3 February 2009)