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COMPARATIVE PERFORMANCE OF UPLAND COTTON FOR YIELD RELATED VARIABLES UNDER SUB-UPLAND AGRO-CLIMATIC CONDITIONS OF BALOCHISTAN

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ABSTRACT

Different commercial cotton cultivars namely Bt. Cotton, BH-147, CIM-497, CIM-506, CIM-511 and Reshmi were studied for their comparative performance during 2012 at Nal district Khuzdar, Balochistan, Pakistan. The experiment was designed in a Randomized Complete Block Design (RCBD) and the genotypes were replicated thrice. These genotypes revealed statistically significant variations for all the studied traits. The cultivars CIM-506, CIM-511 and Bt. Cotton performed better in terms of seed cotton yield and number of sympodia. The cultivar Reshmi was best performing by giving heavier bolls (3.60 g), high ginning out turn (42.61%) and longest fiber length (29.60 mm). The correlation analysis manifested significant and positive association between seed cotton yield plant^{-1} and yield components. Cultivars CIM-506, CIM-511, Bt. Cotton and Reshmi gave more economical yield. On the basis of better varietal performance these varieties are recommended for gaining high yield per unit area.

Keywords: character association, upland cotton cultivars, yield components

INTRODUCTION

Cotton is a main fiber crop grown in arid environment of Pakistan. It has major contribution in the economy of Pakistan and accounts for 7.0 percent of value added in agriculture and 1.5 percent of GDP (Economic Survey of Pakistan, 2013). It provides not only raw material for textile industry but also one of the main export items in the form of cotton lint. The contribution of Punjab and Sindh in area and production of cotton is 80 and 20% across the country which is comparatively greater than Khyber Pakhtunkhwa and Balochistan having combined contribution of 1% only (Cororaton *et al*., 2008). The production of cotton crop on national level during the year 2013 was 12.77 million bales while the yield was 773 kg ha^{-1} (FAOSTAT 2013).

History of cotton cultivation in Balochistan is very old. Based on accumulation of archeological evidence of early cotton in Balochistan. Christophe *et al.* (2002) considered Mehrgarh, Shahi Tump as an earlier use of cotton in the Old World, dating to the 6th millennium BC. The agro-ecological condition of Balochistan has tremendous potential for cotton cultivation including organic cotton production because there is less chances of heavy insect pest attack and diseases infections that can lead to increase in area and production of cotton both horizontally and vertically while in contrast, the cotton production in Punjab and Sindh is under insect pest pressure resulting in low yield per unit area of the country (Ahmad *et al*., 2008). In Balochistan, cotton cultivation trend is increasing and recently 0.038 M ha with 0.098 M bales production has been recorded so far annually (CCRI, 2016). Lasbella, Jafferabad, Nasirabad, Kachhi, Sibi, Kohlu, Dera Bugti, Barkhan, Khuzdar, Turbat (Kech) Kharan, Naushki and Loralai are the main cotton growing districts of the province (GoB, 2014). Small numbers of farmers are growing cotton at present in different areas of Balochistan using uncertified seed which results in low productivity. Arshad *et al.* (2007) reported that growing of inferior cotton varieties is a prime factor responsible for low cotton production. This factor usually limits cotton qualitative and quantitative traits as growth is a function of the product of genotype and environment (Zeng *et al.,* 2014). There is a huge scope of cotton growing if the availability of good quality seeds, improved tools and

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equipment and farmers' skills are enhanced. This consequently will help the farmers of the province for cultivation of cotton on more area with high production (Anonymous (a), 2011). In addition, suitable varieties under different agro-ecological zones have also not been tested and growers are not familiar with the appropriate cultivars to grow in the area. Introduction and identification of proper cotton varieties for the specific ecology play a significant role in cotton yield improvement. Hence variety selection is vital factor and has great influence on growth and development of cotton. Present study was therefore, carried out on six cotton cultivars developed at different cotton research Institutes of Pakistan with a view to evaluate their performance and to select high yielding cultivars best suited to sub-upland environmental conditions of Balochistan, Pakistan. This will also lead to selection of desired traits in the cultivars under study for utilizing them in future breeding programs.

MATERIALS AND METHODS

The experiment was designed and conducted during the cotton growing season, 2012 at Nal district Khuzdar, Balochistan, Pakistan. Khuzdar district is situated between 65°35'35" to 67°24'8" East longitudes and 25°44'4" to 28°51'25" North latitudes with a land altitude from 64 to 2,852 meters above sea level (Anonymous (b), 2011).

Six upland cotton cultivars (Bt. Cotton, BH-147, CIM-497, CIM-506, CIM-511, and Reshmi) were evaluated for various morphological and yield traits. All these cultivars were found resistant to cotton leaf curl virus (CLCV). The experiment was conducted in sandy loam soil with the pH 7.5 and randomized in RCBD (randomized complete block design). Each cultivar was replicated thrice. Each genotype in a replication plot contained five rows (six m long) with p x p and r x r distance of 30.0 and 75.0 cm. Nitrogen and Phosphorus fertilizers were applied @ 125 and 75 kg per hectare as Urea and Nitrophos, respectively. The crop was irrigated as per recommendations while insecticides were applied as and when required. Standard agronomic practices were carried out evenly in all the experimental units throughout the growing season.

The data for yield and its components were recorded for ten randomly tagged index plants in each sub-plot. The observations were recorded on single plant basis for sympodial branches or fruit bearing branches and bolls plant^{-1} were counted and converted into average. From these tagged plants, seed cotton was picked out individually and their weight (g) was determined using electrical balance. Boll weight per plant was calculated by dividing the seed cotton yield per plant with the number of productive bolls per plant. Similarly, lint% was carried out using the formula: lint weight/ total seed cotton weight x 100. The fiber length was determined with the help of digital fibro graph machine and the automated measurements from the screen were recorded in millimeters.

The data were computed through analysis of variance (ANOVA) to find the significant differences among cultivars (Gomez and Gomez, 1984), while LSD test ($P \leq 0.05$) was performed for mean comparison among cultivars by using M Stat-C computer software (Bricker, 1991).

RESULTS AND DISCUSSION

The analysis of variance showed that variations among different traits of cotton cultivars were statistically highly significant at 5% probability level (Table 1). Similar significant differences among cotton cultivars for growth, yield and yield related triats were reported by Baloch *et al.* (2010). Selection of best cultivars to a specific location is of prime importance for possible output. The average performance presented in Table 2 indicated that, cultivars CIM-511, CIM-506, CIM-497 Bt. Cotton and Reshmi are statistically equal by producing 18.70 to 16.87 sympodial branches. Whereas, the cultivar BH-147 was significantly different for this trait and remained lowest ranker in sympodia per plant (14.31). Hu ShouLin *et al*. (2001) while working on cotton also noted significant differences among the various cultivars for morphological traits including sympodia.

For bolls per plant, cultivars CIM-511, CIM-506 and CIM-497 were found statistically same by setting 30.07, 30.04 and 29.47 bolls per plant but differed statistically with rest of varieties. The findings of Jatoi *et al.* (2007) and Tahira *et al.* (2007) are in accordance with this result where cotton cultivars were evaluated for studying their yield and yield related traits.

Mean performance regarding boll weight revealed the existence of significant differences among the cultivars (Table 2). In case of boll weight, Reshmi recorded heavier boll weight of 3.60 g followed by Bt. Cotton (3.41 g). Results further exposed that cotton cultivars have varied capability for producing bigger or smaller bolls. Baloch *et al.* (2010) also recorded substantial variations among cotton cultivars for boll weight.

The Bt. Cotton, CIM-511 and CIM-506 produced maximum seed-cotton plant^{-1} (100.26, 98.03 and 96.43 g, respectively) and were statistically equal with each other. The cultivar BH-147 showed minimum seed-cotton yield of 83.48 g plant^{-1}. Similar findings about seed-cotton yield of various cotton genotypes were reported by Panhwar *et al.* (2008).

Maximum lint (42.61%) was ginned from cultivar Reshmi and remained 1st ranker, followed by Bt. Cotton by ginning with 41.46%. Lowest ginning out turn of 35.05% was recorded in BH-147. The findings of present research for lint % findings were in agreement with those of Baloch (2002). Kakar *et al*. (2013) suggested that selection based on greater GOT% often indicates enhancement in the yield plant^{-1} as well as per unit area.

The most important among the fiber quality properties in cotton is the fiber length from economic and industrial point of view. Results revealed that all the cultivars differ significantly. Reshmi (29.60 mm) followed by the cultivars Bt. Cotton and BH-147 (28.18 mm) measured longest staple length. The lowest mean values (27.55 and 27.43 mm) length however were measured from cultivars CIM-506 and CIM-497, respectively. The results are in line with the results of Niamatullah *et al.* (2007) who also observed significant difference in fiber length among different cotton cultivars.

Relationship between yield and yield components

In addition yield and yield components for all the cultivars were also ascertained via correlation analysis. Correlations between the major yield components for all cultivars are presented in Figures 1 to 6 and Table 3. The extent of relationship exhibited that sympodial branches, number of bolls and boll weight plant^{-1} was positively and significantly associated with seed cotton yield with r value of 0.525, 0.646 and 0.345 respectively (Table 3). However, sympodial branches plant^{-1} with the lower correlation coefficient values of r = 0.271 and 0.253 showed no significant correlation with number of bolls and boll weight plant^{-1} (Figure 1, 3). In addition, negative correlation (r = − 0.491) was observed between number of bolls and boll weight plant^{-1} (Figure 4).

Correlation coefficients revealed that a unit increase in sympodial branches, number of bolls and boll weight plant^{-1} resulted in corresponding increase in seed-cotton yield plant^{-1} by 2.31, 2.015 and 10.71 g. Obviously sympodia per plant and bolls per plant are the direct contributors of yield and affect in a straight line genotypically as well as phenotypically on seed-cotton yield. However relationship of sympodia per plant with boll weight was non-significant. This is expected as sympodia do not contribute to boll weight. Bolls plant^{-1} were significantly but negatively (r = −0.491**) associated with boll weight. It suggests that reduction in boll weight might be due to escalation in bolls plant^{-1} (Table 3). Since, the existence of strong association between seed-cotton yield and number of bolls plant^{-1}, any change in one character in either of the direction will bring corresponding change of equal intensity to the other attribute in that specified direction. Many researchers have reported similar extent of relationship between seed-cotton yield and its components (Larik *et al.,* 1999; Iqbal *et al.,* 2003; Panday *et al.*, 2003; Tahira *et al.,* 2007 and Shazia *et al.*, 2010).

Table 1. Mean squares for some polygenic characters of upland cotton at Khuzdar, Balochistan

Sources	**DF**	**No. of sympodial branches**	**Number of bolls plant^{-1}**	**Boll weight (g)**	**Seed-cotton yield plant^{-1} (g)**	**G.O.T. (%)**	**Fiber length (mm)**
Replication	2	0.514	1.292	0.022	1.228	0.101	0.787
Varieties	5	6.265*	21.50**	0.117*	159.27**	21.03**	1.79**
Error	10	1.171	3.38	0.026	5.432	0.153	0.03
CV%		6.38	3.81	4.91	2.54	0.99	0.62
P-Values		0.0119	0.0005	0.0207	0.0000	0.0000	0.0000
SE		0.88	0.87	0.13	1.90	0.32	0.14
CD 5%		1.75	1.73	0.26	3.77	0.63	0.28
CD 1%		2.32	2.29	0.34	5.00	0.84	0.37
Grand mean		16.97	28.08	3.28	91.84	39.59	28.16

**Significant at 0.01 probability level, * Significant at 0.05 probability level, NS= Non- significant

Table 2. Mean performance of six upland cotton cultivars for some quantitative traits

Cultivars	Sympodial branches plant^{-1}	Bolls plant^{-1}	Boll weight (g)	Seed cotton yield plant^{-1} (g)	G.O.T (%)	Fiber length (mm)
CIM-511	18.70a	30.07a	3.26bc	98.03a	40.50c	28.04b
CIM-506	17.33a	30.04a	3.22bc	96.43a	39.29d	27.55c
CIM-497	17.28a	29.47a	3.16bc	84.63bc	38.63d	27.43c
Bt. Cotton	17.32a	27.51b	3.41ab	100.26a	41.46b	28.18b
BH-147	14.31b	26.85b	3.04c	83.48c	35.05e	28.18b
Reshmi	16.87a	24.54c	3.60a	88.19b	42.61a	29.60a

Table 3. Correlation coefficient (r) for yield and yield components of six upland cotton Varieties

Traits	Seed cotton yield plant^{-1}	No. of sympodia plant^{-1}	Number of bolls plant^{-1}	Boll weight	Ginning outturn %
No. of sympodia plant^{-1}	0.52**	-			
Number of bolls plant^{-1}	0.65**	0.27 $^{n.s}$	-		
Boll weight	0.35*	0.25 $^{n.s}$	-0.49**	-	
Ginning outturn %	0.52**	0.61**	-0.06 $^{n.s}$	0.69**	-
Fiber length	0.12 $^{n.s}$	-0.15 $^{n.s}$	-0.64**	0.67**	0.46*

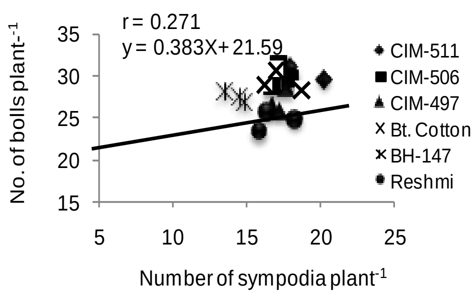

Figure 1. Relationship of number of sympodia with number of bolls plant^{-1}

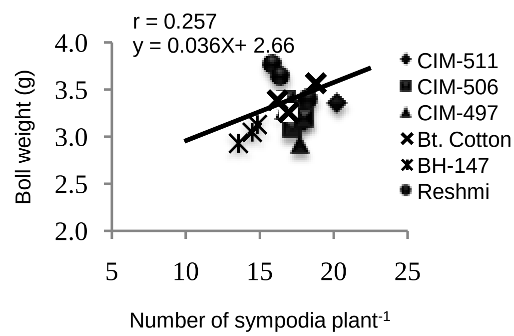

Figure 3. Relationship of number of sympodia with boll weight

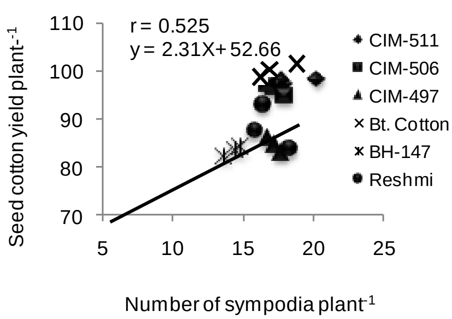

Figure 2. Relationship of number of sympodia with seed-cotton yield

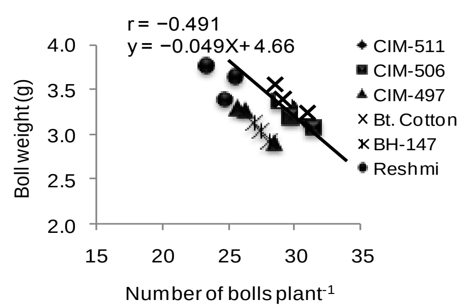

Figure 4. Relationship of number of bolls with boll weight

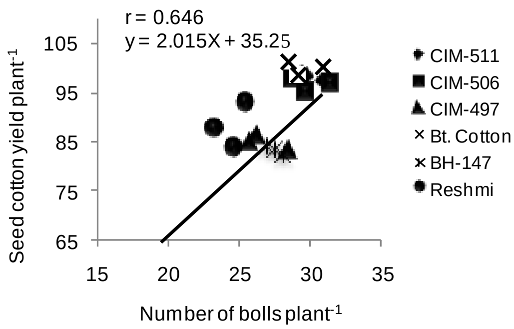

Figure 5. Relationship of number of bolls with seed-cotton yield

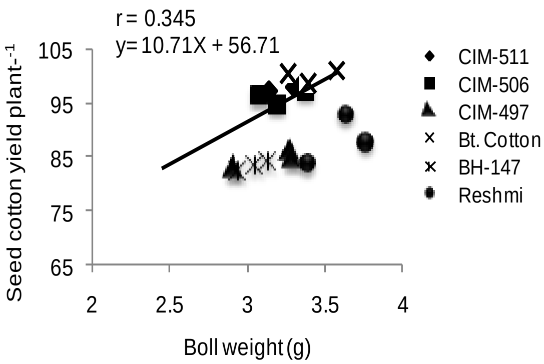

Figure 6. Relationship of boll weight with seed-cotton yield

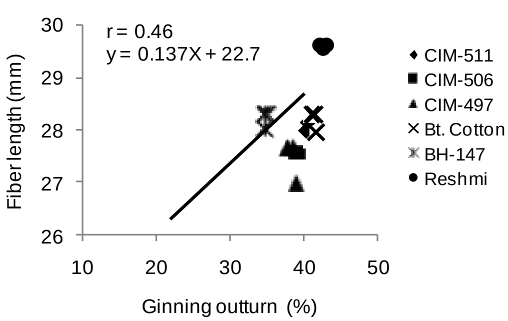

Figure 7. Relationship of GOT % with Fiber length

CONCLUSION

This study comprised of six cotton cultivars *viz.* Bt. Cotton, BH-147, CIM-497, CIM-506, CIM-511 and Reshmi. The analysis of variance showed significant differences among the aforesaid cotton varieties for most of the quantitative attributes. The cultivars CIM-506, CIM-511 and Bt. Cotton performed better in terms of seed-cotton yield and number of sympodia. On the basis of the mean performance, the cultivar Reshmi was the best among cultivars in terms of giving heavier bolls, high ginning out turn and measuring longest fiber length. In addition, cultivars CIM-506, CIM-511 and Bt. Cotton also gave more economical yield per unit area. Hence these genotypes may be recommended for general cultivation in upland zone of Balochistan (Khuzdar, Loralai, Zhob, Barkhan, etc). All the yield components like number of sympodial branches per plant, bolls per plant and boll weight revealed significantly positive association with seed-cotton yield per plant. Besides, significant and positive correlation was also observed between ginning outturn % and staple/fiber length. Therefore for future breeding program, these yield attributes could be exploited as an indirect selection criteria for improving seed-cotton yield.

REFERENCES

Ahmad, W., N. U. Khan, M. R. Khalil, A. Parveen, U. Aimen, M. Saeed, Samiullah and S. A. Shah. 2008. Genetic variability and correlation analysis in upland cotton. Sarhad Journal of Agriculture, 24: 573-580.

Anonymous (a) 2011. Outgoing year proved dull for Balochistan www.dawn.com a website.

Anonymous (b) 2011. District profile, Planning and Development Department, Government of Balochistan. Pp. 6-9.

Arshad, M., A. Wajid, M. Maqsood, K. Hussain, M. Aslam and M. Ibrahim. 2007. Response of growth, yield and quality of different cotton cultivars to sowing dates. Pakistan Journal of Agriculture Science, 44 (2): 208-212.

Baloch, M. J. 2002. Relative performance of F_1 and F_2 intrahirsutum hybrids for some polygenic traits in upland cotton. Pakistan Journal of Scientific and Industrial Research, 45 (6): 407-411.

Baloch, M. J., M. S. Kakar, W. A. Jatoi and N. F. Veesar. 2010. Identification of potential F_2 populations from intraspecific crosses in upland cotton. Pakistan Journal of Scientific and Industrial Research, 53 (3): 151-157.

Bricker, B. 1991. MSTATC: A micro computer programme from design management and analysis of Agronomic Research Experiment. Michigan State University, USA.

CCRI, 2016. Daily cotton market Report. http://www.ccrim.org.pk/stat_cotton.html

Christophe, M., M. Tengberg, J. F. Haquet and B. Mille. 2002. First evidence of cotton at Neolithic Mehrgarh, Pakistan: Analysis of mineralized fibers from a copper bead. Journal of Archaeological Science, 29, 1393-1401.

Cororaton, C. B., A. Salam, Z. Altaf, D. Orden, R. Dewina, N. Minot and H. Nazli. 2008. Cotton-textile apparel sectors of Pakistan; situations and challenges faced. International Food Policy Research Institute (IFPRI). Discussion Paper 00800, September 2008.

Economic Survey of Pakistan. 2013. Agriculture, Islamabad: Government of Pakistan.

FAOSTAT (FAO Statistical Service) 2013. At http://faostat.fao.org, Food and Agriculture Organization of the United Nations, Rome.

GOB, 2014. Crop Reporting Services, Agriculture Statistics Government of Balochistan.

Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. John Willey and Sons Inc., 2^{nd} (Ed.), New York, U.S.A.

HouLin, H., M. YongJun, G. Ping, C. X. Chuan, Z. Chao and H. LiangRong. 2001. Genetic analysis of the yield and morphological traits of F_2 of upland cotton. China Cottons, 28 (8): 9-10.

Iqbal, M., M. A. Chang, M. Z. Iqbal, M. U. Hassan and K. Mahmood, 2003. Genetic analysis of earliness and agronomic characters in upland cotton. Sarhad Journal of Agriculture, 19. (3): 353-357.

Jatoi, A. W., M. J. Rind, N. F. Veesar, S. A. Panhwar, N. A. Panhwar and M. S. Majeedano. 2007. Genetic analysis of some quantitative character in F_2 population of intra-hirsutum crosses. Pakistan Journal of Seed Technology, 1 (10): 45-53.

Kakar, M. S., M. Ibrar, S. A. Taran, T. A. Baloch and M. N. Tareen 2013. Evaluation and performance of some selected parental line of upland cotton (*Gossypisum hirsutum* L.) and their F_2 progenies for some polygenic traits. Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences, 29 (1): 24-30.

Larik, A. S., A. A. Kakar, M. A. Naz and M. A. Shaikh. 1999. Character correlation and path analysis in seed cotton yield of *Gossypium hirsutum* L. Sarhad Journal of Agriculture, 15 (4): 269-274.

Niamatullah, K., H. U. Khan, K. Usman, U. K. Hayat and S. Alam. 2007. Performance of selected cotton cultivars for yield and fiber related parameters. Sarhad Journal of Agriculture, 23 (2): 257-259.

Pandey, S. K., P. Singh and S. B. Pandey, 2003. Analysis of character association in upland cotton (*Gossypium hirsutum* L.). Progressive Agriculture Society for Recent Development in Agriculture, Rawatpur India, 3 (1/2): 139-140.

Panhwar, S. A., M. J. Baloch, W. A. Jatoi, N. F. Veesar and M. S. Kakar. 2008. Genetic parameters for earliness and fibre triats estimated from line x tester analysis in upland cotton. Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences, 24 (1): 20-26.

Shazia, S., S. Abro, A. Rehman and K. Iqbal. 2010. Correlation analysis of seed cotton yield with some quantitative traits in upland cotton (*Gossypium hirsutum* L.). Pakistan Journal of Botany, 42 (6): 3799-3805.

Singh, P. 2004. Cotton breeding. Kalyani Publisher. New Delhi, India.

Tahira, J., H. Abro, A. S. Larik and Z. A. Soomro. 2007. Performance of different cotton varieties under the climatic conditions of Jamshoro. Pakistan Journal of Botany, 39 (7): 2427-2430.

Zeng, L., W. R. M. Jr., B. T. Campbell, J. K. Dever, J. Zhang, K. M. Glass, A. S. Jones, G. O. Myers and F. M. Bourland. 2014. Breeding and genetics. Genotype-by-environment interaction effects on lint yield of cotton cultivars across major regions in the U.S. cotton belt. Journal of Cotton Science, 18: 75-84.

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