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CHARACTER ASSOCIATION OF YIELD AND ITS COMPONENTS IN UPLAND COTTON, *GOSSYPIUM HIRSUTUM* L.

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ABSTRACT: Six American upland cotton varieties, namely, CRIS-9, CRIS-5A, CRIS-134, CIM-496, CIM-499 and CIM-506 were compared for their average performance and character association at Junejo Farm Talho Malho near Umerkot during 2017. Characters studied were earliness (first sympodial node number, days to open first flower and first boll, first pick at 90 days after sowing and second pick at 130 days after sowing), yield (yield per plant, yield per hectare), yield related characters (number of sympodia per plant, number of bolls per plants, boll weight and seed index) and ginning outturn. Correlation coefficients were also determined between all possible combinations of above characters. The most economically important combination form cotton grower's point of view is the seed cotton yield which was highly, positively and significantly correlated with first sympodial node number (r=0.616), number of sympodial branch (r=0.828) days to open first flower (=0.516) and first boll (r=0.656), number of bolls per plant, (r=0.644) and boll weight (r=0.700). This shows strong associated with earliness attributes and also with yield contributing attributes. Similarly, days to open first flower show highly significant positive correlation (r=0.728) with first boll opening and with number of bolls per plant (r=0.566). Number of bolls per plant was also highly and positively correlated with seed cotton yield (r=0.644) and first sympodial node number (r=0.786) it means 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.

Keywords: Cotton, varieties, earliness, character association, yield components.

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INTRODUCTION

Cotton (*Gossypium spp*.) belongs to the Malvaceae family. Pakistan is ancient homeland of indigenous cultivated cotton *Gossypium arborium* L. Presently, American upland cotton, *Gossypium hirsutum* L. is predominantly cultivated in most of the cotton producing countries of the world including Pakistan and is one of the most important fibre crops playing pivotal role in economic and social orders of the world (Aaron *et al*., 2017 and Shuli *et al*., 2018). World trade is expected to increase to 42.3 million bales in 2018-19, the highest level since 2012-13's record. A record crop in Brazil is driving its exports to a record-high, while import dependent countries, such as Vietnam and Bangladesh, are also set to reach their highest level of imports. China imports are forecast to increase 31.0 percent, but the continued reduction in state reserve stocks limits import opportunities. These import gains are expected to more than offset slower demand from Turkey and Pakistan (Dohlman *et al.,* 2019). During 2017-18, cotton production stood at 11.935 million bales and recorded growth of 11.8 percent over the production of 10.671 million bales during same period last year. Cotton crop has 1.0 percent share in GDP and contributes 5.5 percent in agriculture value addition. Cotton crop was cultivated on an area of 2,699 thousand hectares as compared year's area of 2,489 thousand hectares an increase of 8.4 percent (GOP, 2017-18).

The suitability of environmental conditions for cotton cultivation in the country is obvious from its area under cultivation (Cotistics, 2002). Yet on the national level, the cotton yield is still low and lagging behind as attention for the genetic improvement as a number of high yielding cultivars possessing good fibre qualities have been evolved. Science it is not possible to allocate more land for cotton production at the cost of other crops, more intensive efforts are required to increase cotton production from the area available for it (Anonymous. 2004-2005).

In most of the cotton producing countries, efforts are being made to breed for early maturing and more determinate cotton varieties. In some countries, the breeding programs are continued over many years with the objective to develop varieties which can best be grown in a season restricted by temperature. In many other countries, the main objective is to breed varieties which escape late season, insect attacks and facilitate production of a food crop and cotton crop in one year (Mehta and Arias, 2001).

Shah *et al*. (2010) observed two selection criteria for earliness in cotton. First based on early and rapid flowering coupled with short boll maturation period (BMP). The second criteria based on low number of Nodes of first sympodia (NNFS) coupled with less total number of main stem nodes (TNOD) of the main stem. Afiah and Ghoneim (2000) concluded that plant height, days to first flower and days to first open boll would be good criteria for selection of individual plants for early maturity because these traits have the highest heritability estimates and generally show significant and desirable associations with other components of earliness. The highest yields were achieved by the least determinate and slowest maturing genotypes. Yields generally decreased as the determinacy increased and rate of maturity was accelerated (Soomro, 2005).

Breeders are putting emphasis on the development of short season varieties not only to fit into shorter season environments but also to reduce the time for insect damage. They pointed out that as yields, quality and disease resistance is raised to the levels of competitive with full season varieties they are also associated with earliness. However, it is desirable for plant breeders to know the extent of relationship between yield and its various components which will facilitate them in selecting plants of desirable characteristics. The knowledge of relationship among various yield components has been successfully exploited towards cotton improvement. Correlation study is an important asset to cotton breeders to determine the relationship between yield and earliness characters or between various factors contributing to seed cotton and lint yield. It also happens that due to character association, improvement in respect of one character may have been obtained at the expense of the other (Soomro, 1999).

The present studies were therefore, carried out in six cotton varieties developed at Central Cotton Research Institutes, Multan and Sakrand with a view to examine correlation trends among these cultivars to determine the extent of association between yield and its components as a first hand information to be used for further improvement and development of new early maturing and high yielding varieties of cotton crop. This will also lead to selection of desired combinations of traits in the varieties under study for improving yield potential of targeted cultivars.

MATERIALS AND METHODS

Six upland cotton cultivars, out which three namely, CRIS-5A (Marvi), CRIS-9 and CRIS-134 belonged to Central Cotton Research Institute, Sakrand, Sindh and others three namely CIM-496, CIM-499 and CIM-506 belonged to Central Cotton Research Institute, Multan, Punjab. The obtained seed was sown at Junejo Farm Talho Malho near Umerkot during 2017 in a randomized complete bock design with four replications. Each replication plot contained five rows each of 20 feet length. The distance between rows was kept as 2.5 feet and between plants was maintained at 9 inches. Recommended package of production technology was followed during sowing and after planting of the experimental plot. Field preparation and other methods of Farooq *et al*. (2013) were used. Ten plants of each cultivar in each replication were selected at random for recording the data at maturity. The data were recorded on single plant basis on all randomly selected plants per treatment/entry per replication.

The correlation coefficients, coefficients of the determination and student's "t" values to best the significance of correlation coefficient were calculated for all the nine characters combinations as follows:

Sr. No.	Characters	Character associations
1	Main stem node number (MNS) of first sympodial branch	v/s Number of sympodial branches / plants, Days to open first flower, Days to open first boll, Total number of bolls per plant, Boll weight (g), G.O.T%, Seed index, Seed cotton yield per plant.
2	Number of sympodial Branches/plant	v/s Days to open first flower, Days to open first boll, Total number of bolls per plant boll weight (g), G.O.T % Seed index, Seed cotton yield per plant.
3	Days to open first flower	v/s Days to open first boll, Total number of bolls per plant, Boll weight (g), G.O.T %, Seed index, Seed cotton yield per plant
4	Days to open first boll	v/s Total number of bolls per plant, Boll weight (g), G.O.T %, Seed index, Seed cotton yield per plant.
5	Total number of bolls per Plant	v/s boll weight (g), G.O.T %, Seed index, Seed cotton yield per plant.
6	Boll weight (g)	v/s G.O.T % Seed Index, Seed cotton yield per plant.
7	G.O.T%	v/s Seed index, Seed cotton yield per plant.
8	Seed index	v/as Seed cotton yield per plant.

Fig. 1. Different characters of cotton plants.

The data (average performance of cultivars) were statistically analyzed through analysis of variance (ANOVA). The means of the cultivars of various characters were compared with the help of Duncan's Multiple Range test (DMR). The values of simple correlation coefficients, coefficients of determination and student's "t" test alongwith their probability levels were calculated by using MSTAT computer programme of Michigan State University, East Lancing, Michigan USA.

RESULTS AND DISCUSSION

Sympodial node number: For sympodial node number, CRIS-9 scored 12^{th} node of the main stem on which first sympodial branch came while CIM-499 scored 7.8 (or 8^{th} node) where first sympodial branch started. Other varieties ranged in between these values and were grouped in the DMR test accordingly. This means that 12^{th} node of CRIS-9 would be little bit higher than the ground surface, where the variety as compared to CIM-499. This attribute of CRIS-9 would not allow bolls to rot or wither due to weeding, irrigation and fertilizer application as sympodial branch would be comparatively in higher position above the ground against CIM-499. Low positioned first sympodial branch of CIM-499 would be more vulnerable to such Vagaries and may cause newly set flowers and bolls to shed and opened to rot their seed cotton due to their drooping in irrigation water. Similarly, Khan (2003) observed highest number of nodes (10.6) for MNH-93 whereas CIM-443 developed the least no of nodes (6.2) to first sympodia. Farooq *et al*. (2013) also observed similar associations of sympodial nodes.

Sympodial branches plant^{-1}: Variety CRIS-134 gave highest number of 17.25 sympodial branches per plant followed by other CIRS varieties as they grouped in the same range in the DMR test for number of sympodial branches per plant. Accordingly, CIM varieties grouped together in the DMR test giving lower number of sympodial branches per plant, the lowest being CIM-499 giving 11.25 sympodia. Whereas, Tariq *et al.* (2017) showed significantly 25. 78 number of sympodial branches per plant for CIM-496. Number of sympodial branches per plant is very good indicator of seed cotton yield per plant as the sympodia mean boll bearing / fruit bearing branches in cotton. Thus, more number of sympodia would give more number of bolls per plant and consequently more seed cotton yield per plant. CRIS varieties gave more sympodia as compared to CIM varieties which are bred in Multan in Punjab and less adaptive to local Sindh conditions. Nehra *et al*. (1986), Aslam *et al*. (2013) also reported closely related findings to current study.

Days to open first flower: For the trait days to open first flower, statistically all the varieties were categorized in the same group and were non-significant. All the varieties took 47 to 50 days to open their first flower. Ahmad *et al*. (2008) also found that new strain VH-144 and VH-156 exhibited great yield potential for earliness as they took minimum days to first flower 40.5 and 41.4 respectively and produced more boll opening percentage at 120 days after planting 81 and 80.9 respectively. Least significant difference of 4 to 5 days in a variety cannot bring significant change in its earliness to open their flowers and consequentially the bolls. Earliness in cotton is desired attribute as early picked crop would vacate the field early as compared to late varieties which offer more time (number of days) to prepare for the rabi crop (may be wheat and brassicas). These results are also comparable to the findings of Awan *et al.* (2011). These research workers have also warned that early cotton crop would yield less because it takes less number of days to open the bolls of entire crop.

Days to open first boll: For number of days taken by the plants to pen their first mature boll, similarly all the varieties got categorized in the same group of DMR test suggesting as in case of days to open first flower that all the varieties opened their first boll with small difference from 87.25 to 91.5 days. Analysis of variance of the data for the trait presented in Table-1 showed non-significant mean squares. Whereas, Ahmad *et al*. (2008) observed wide range of variation from 53.0 to 81.0 % and found that new strain VH-144 and VH-156 exhibited great yield potential for earliness as they produced more boll opening percentage at 120 days after planting 81 and 80.9 respectively. Similar results were also observed by Seilsepour *et al.* (2012). Earliness in cotton is very tricky character, cotton breeders would always want to bring earliness with high yield and in some breeding programmes they have made a success (CIRS-134 is the glaring example) but cotton growers might not go for early crop as they would not bring their cotton fields into wheat after cotton picking due to their poor social-economic conditions or other constraints. Most of the breeders opine that earliness in cotton is linked with less yield but this linkage has been broken by Sindh Cotton breeders and varieties like CRIS-5A (Marvi), CRIS-134 and CIRS-467 (CLCV resistant also) have been evolved and commercialized.

Seed cotton yield plant^{-1}: For seed cotton yield per plant at first pick (90 days after planting), the mean performance of varsities (Table-1) shows that CIM-506 gave the highest yield of 6.572 g per plant followed by CRIS-9 with 6.127 g whereas lowest yielding was CIM-496 with 1.43 g per plant. These results are in similarity with the observations shown by Heithol (2001); Godoy (2004); Adem (2006); Surriya (2006). But in case of seed cotton yield per plant at second pick after 130 days, results showed that CRIS-9 and CRIS-134 produced highest seed cotton per plant (59.0 g and 50.7 g respectively) and were in the same group of DMR test, whereas, lowest yield was acquired from CIM-499 and CIM-496 with 37.54 and 40.58 g respectively and were low yielding in DMR test group. The analysis of variance also showed non-significant mean squares values. Sahito *et al.* (2015) also found that cotton variety NIAB-78 proved as a superior variety with significant highest seed cotton yield per plant of 151.36 g followed by varieties Shahbaz-95 and TH-224/87 with average seed cotton yield per plant of 136.94 g and 135.58 g respectively. Whereas, the lowest per plant yield of 134.25 g was obtained from variety Sindh-1.

Number of bolls plant^{-1}: Form table-1 shows that for the trait number of bolls per plant, variety CRIS-9 produced highest number of bolls per plant followed by CRIS-134 and least number of bolls were given by CIM-499 followed by CIM-496. DMR test also showed significant differences. The results also support the findings of previous workers in to as the boll number is absolutely environmentally dependent and positively correlated with yield. Generally, CRIS varieties were better in performance as compared to CIM varieties because of their better adaptability under Sindh conditions since their cultivation. Sahito *et al*. (2015) for the trait number of bolls per plant found that variety NIAB-78 produced maximum number of bolls (44.66) per plant, followed by variety Shahbaz-95 with 36.44 bolls per plant, while the minimum number of bolls were recorded in the varieties TH-224/87 and Sindh-1 with 34.66 and 34.11 per plant, respectively. Anwar *et al*. (2002) also find out that due to differences in their genetic potential varieties behave differently for the number of bolls plant^{-1}. Pandy *et al.* (2003) also reported similar type of results in their study.

Boll weight plant^{-1}: Data regarding the trait boll weight in the Table-1, revealed the non-significant differences existed to differentiate the mean performance of cultivars as DMR test results and mean squares from analysis of variance were also non-significant. The difference between heavier boll weight of 3.29 g for CIM-499 and lowest boll weight of 2.60 g for CRIS-5A was hardly 0.6 g which does not carry much importance. These results also suggested that selection on the basis of boll weight will not yield fruitful results because of nonsignificant means. Similar results were also observed by Khan *et al*. (2017) that out of seven genotypes, DNH-105 produced highest 3.07 g boll weight followed by CIM-616 with 2.93 g boll weight. Non-significant boll weight results to compare the mean performance of varieties were also obtained by Jan *et al*. (2017). Boll weight is one of the important components of seed cotton yield and directly correlated with it but negatively associated with number of bolls per plant. Therefore, if heavier bolls varieties are sown, increased yields would be obtained.

Ginning Out-turn (G.O.T%): Mean performance of varieties (Table-1) showed highly significant differences and reveal that for the ginning outturn percent, CIM-506 produced highest ginning percent of 42.37% followed by CIM-496 with 41%. The. Lowest ginning outturn of 33.75% of CIM-499 was also grouped with CRIS-134 (38.775% G.O.T %). According to Sahito *et al*. (2015) among varieties, NIAB-78 performed better with highest G.O.T.% of 34.43 followed by variety Sindh-1 with 32.20 G.O.T. percent, while lower G.O.T. of 31.87 and 31.86 percent was recorded in varieties Shahbaz-95 and TH-224/87, respectively. Ali *et al.* (2003) also reported similar type of outcomes for the trait G.O.T percent. Ginning outturn is a quality character and is dependent on the intensity of fiber with which it is attached to the seed coat. The greater the force by which fiber is attached to seed coat the less will be the ginning outturn. Therefore, breeders would must emphasize on evolving high ginning percent varieties only for the industry like cotton ginning factories and spinning mills.

Seed index: Seed index or 100 seed weight is an important character for determining the yield, especially in seed cotton. For seed Index, the result through analysis of variance on mean performance comparison reveals significant differences with highest seed index of 6.75 g for varieties CRIS-9, CIM-496 and CIM-499 whereas lowest was 5.75 g for CRIS-5A. Deho *et al*. (2014) also showed maximum seed index (7.44g) for variety Sadori followed by variety Chandi-95 with seed index of 7.42g. Oad *et al*. (2002) also observed genotype Rehmani as better performing with 8.48 g seed index. On the basis of individual plant. Seilsepour *et al.* (2012) also reported similar findings.

Seed cotton yield: Yield of seed cotton per plant had thereby per hectare is the ultimate objective of cotton breeders and cotton growers simultaneously. In the present studies, per plant yield result were non-significant but per ha yields were highly significant. Such differences are attributed to plant population ha^{-1}, number of sympodial branches per plant and number of bolls per plant. These attributes on ha^{-1} basis must support and contribute to per ha yield otherwise seed cotton yield will be low. Related studies were observed by (Savakumari and Mohan (2009). From present results it is also conclude that CRIS varieties are high yielding and well adopted to Sindh climatic conditions as compared to Multan CIM varieties.

Table-1: Mean performance of six American Upland cotton cultivars for twelve quantitative traits.

Characters	CRIS-5A	CRIS-9	CRIS 134	CIM 496	CIM 499	CIM506
1st sympodial node number	10.75 ab	12.35 a	9.95 bc	8.5 cd	7.8 d	7.9 d
No. of sympodial branches	17.0 a	16.0 a	17.25 a	12.25 b	11.25 b	11.75 b
Date of opening 1st flower	50.25 ns	48.25 ns	47.75 ns	50. 75 ns	48.00 ns	47.00 ns
Date opening 1st boll	91.5 ns	87.75 ns	87 .25 ns	90.75 ns	90.0 ns	89.75 ns
Seed cotton yield 90 days after sowing (g)	1.43 ab	6.127 a	4.516 a	2.579 b	4.664 ab	6.572 ab
Seed cotton yield 130 days after sowing (g)	43.180 ab	59.00 a	50.739 a	40.575 c	37.54 ab	45.728 a bc
Number of bolls per plant	17.02 ab	23.7 a	21.95	14.2 b	11.3 b	13.34 ab
Boll weight (g)	2.602 ns	2.658 ns	2.561 ns	2.748 ns	3.289 ns	2.742 ns
Seed cotton yield per plant (g)	44.61 ns	65.107 ns	55.251 ns	43.15ns	42.206ns	43.301 ns
G.O.T (%)	40.475 bc	39.376 cd	38.775d	41.0 ab	33.75 d	42.375a
Seed index (g)	5.75 b	6.75 a	6.0 ab	6.75	6.75 a	6.0 ab
Seed cotton yield (kg ha^{-1})	1800	2470	2582.5	1977.5	1118.75	1983.75

Correlation analysis: Correlation of sympodial node number on main stem with number or sympodia per plant, days to open first flower and first boll, number of bolls per plant and seed cotton per plant was significantly positive. It may not be out of place to mention here that first sympodial node number reflect earliness of cotton the lower the first sympodial node number, cotton plant will set early flower. Positive correlation between above mentioned characters indicates that earliness can well be combined with seed cotton yield and its main contributing factors. Jagtap *et al.* (2010); Deho *et al.* (2012) also explained that earliness can also be combined with seed cotton yielding ability of plant and improvement can be brought about with careful targeted selection.

As a general rule, early cotton is low yielding because the time to recover the sympodia in getting their fruit (bolls) development, maturity and opening is less available as compared to late or full seasoned cotton cultivars (Brar *et al*., 2015). But when such linkages have been broken by research workers, the cotton growers must obtain benefit of such elegant research results and choose early maturing and high yielding varieties. First sympodial node number did not show any relationship with boll weight, ginning out turn and seed index as the correlation coefficients are positively non-significant. Hussain *et al.* (2000); Ghule *et al.* (2013) also presented same related results.

Days to open first flower and thereby first boll are interrelated characters and dependent upon each other. They show highly significant positive correlation (r=0.728) and therefore both effect earliness. For both the attributes, their relationship with seed cotton yield was significantly positive. This means that, more the number of days per plants will take to open their flowers and bolls, more days will be required for crop to mature and seed cotton yield thereby will be more. Such attributes, thus, support full seasoned (not short season) cotton crop. The utilization of these attributes by cotton growers depends on their priority whether they are interested to vacate (pick) cotton crop early and bring wheat crop immediately. Days to open first boll was significantly and positively correlated with number of bolls per plant (r=0.566). This implies that more number of days would be taken by cotton plant to open its first boll, the more will be the number of bolls in that plant. Ahmad *et al.* (2008) observed highly positively significant correlation existed between days taken to first flower and sympodial branch node number with first effective boll (r= 0.807), days taken to first flower and boll opening percentage at 120 days after planting (r= 0.705), sympodial branch node number with first effective boll and boll opening percentage at 120 days after planting (0.501), whereas negative correlation was found between sympodial branch length and boll opening percentage at 120 days after planting (r=-0.663), boll weight and seed cotton yield (r=-0.281). Similarly, other researchers like Kaynak *et al.* (2000); Zhang and Kong (2001); Amutha *et al.* (2006); Mandloi (2006) also showed similar results in agreement with our results.

Number of bolls per plant was highly and positive correlated (Table-2) with seed cotton yield (r=0.644), number of sympodia per plant and first sympodial node number (r=0.786). These attributes have already been discussed in the earlier paragraphs. Since boll number per plant and seed cotton yield per unit are strongly associated, 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. All of our results have also been reported similarly by hundreds of research workers. Few to mention are Hussain *et al.* (2000), Satange *et al.* (2000), Afiah and Ghoneim (2000), Panday *et al.* (2003). On the other hand, boll weight did not furnish any relationship with ginning outturn and seed index, similarly seed index and seed cotton yield plant^{-1}were also non-correlated. Same was the case of seed index with seed cotton yield ha^{-1}, all these findings are in line with many of the research workers and few of them are already described earlier in this paragraph.

The most economically important combination of attributes form cotton grower's point of view would be seed cotton yield, highly, positively and significantly correlated with first sympodial node number (r=0.616), number of sympodial branch (r=0.828), days to open first flower (=0.516) and first boll (r=0.656), number of bolls per plant, (r=0.644) and boll weight (r=0.700). This shows that in the present material, seed cotton yield is strongly associated with earliness attributes and also with yield contributing attributes. This is very encouraging for cotton growers as they can safely grow early maturing and high yielding varieties without scarifying time to grow wheat after picking early cotton crop. Savakumari and Mohan (2009) also observed significantly positive correlation amongst cotton characteristics.

Table-2: Estimates of correlation coefficients and coefficients of determination in all possible combinations of nine quantitative traits in American upland cotton, *Gossypium hirustum* L, cultivars.

Sr. No.	Character combination	Correlation coefficient (r)	Coefficient of determination (r^2)	Student's value	Prob.
1	MNS node number of 1st sympodial branch v/s Number of sympodial branches per plant	0.700**	0.49	4.596	0.000
2	Days of opening 1st flower	0.397*	0.157	2.029	0.054
3	Days to opening 1st boll	0.513**	0.263	2.801	0.010
4	No. of bolls/plant	0.786**	0.617	0.180	0.009
5	Boll weight (g)	0.095	0.0090	0.447	0.659
6	G.O.T%	0.048	0.0023	0.225	0.824
7	Seed index	0.106	0.011	0.500	0.622
8	Seed cotton yield per plant	0.616**	0.379	3.667	0.001
9	Number of sympodial branch v/s days of opening 1st flower	0.039	0.0015	0.183	0.856
10	Number of sympodial branch v/s days of opening 1st boll	0.236	0.055	1.141	0.266
11	Number of sympodial branch v/s number of bolls/plant	0.709**	0.503	3.601	0.002
12	Number of sympodial branch v/s boll weight (g)	0.172	0.029	0.817	0.422
13	Number of sympodial branch v/s G.O.T%	0.120	0.014	0.565	0.578
14	Number of sympodial branch v/s seed index	0.334	0.111	1.663	0.110
15	Number of sympodial branch v/s seed-cotton yield/plant	0.828**	0.710	1.304	0.002
16	Days to opening 1st flower v/s days of opening 1st boll	0.728**	0.529	4.983	0.000
17	Days to opening 1st flower v/s No. of bolls per plant.	0.380	0.144	1.925	0.067
18	Days to opening 1st flower v/s bolls weight (g)	0.205	0.042	0.982	0.336
19	Days to opening 1st flower v/s G.O.T%	0.065	0.004	0.305	0.763
20	Days to opening 1st flower v/s seed index	0.041	0.001	0.192	0.849
21	Days to opening 1st flower v/s seed cotton yield/plant	0.516**	0.264	2.149	0.012
22	Days to opening 1st boll v/s No. of bolls/plant	0.566**	0.320	3.217	0.004
23	Days to opening 1st boll v/s boll weight (g)	0.398*	0.158	2.033	0.054
24	Days to opening 1st boll v/s G.O.T%	0.129	0.016	0.611	0.547
25	Days to opening 1st boll v/s seed index	0.076	0.005	0.358	0.723
26	Days to opening 1st boll v/s seed cotton yield/plant	0.656***	0.430	4.077	0.000
27	Number of bolls/plant v/s boll weight (g)	0.060	0.003	0.282	0.781
28	Number of bolls/plant v/s G.O.T%	0.038	0.001	0.180	0.859
29	Number of bolls/plant v/s seed index	0.069	0.004	0.323	0.750
30	Number of bolls/plant v/s seed cotton yield/plant	0.644**	0.414	3.944	0.001
31	Boll weight (g) v/s G.O.T%	0.088	0.007	0.416	0.681
32	Boll weight (g) v/s Seed index	0.157	0.024	0.746	0.463
33	Boll weight (g) v/s seed cotton yield/plant	0.700***	0.49	4.597	0.000
34	G.O.T (v/s seed index	0.283	0.080	1.383	0.180
35	G.O.T v/s seed cotton yield/plant	0.035	0.001	0.163	0.872
36	Seed index v/s seed-cotton yield/plant	0.132	0.017	0.626	0.537

Conclusion: The CIM varieties were less adaptive under Sindh conditions and were more vulnerable to genotype-environment interaction as compared to CRIS varieties. Correlation studies revealed that yielding capability of any variety was not associated with earliness in CIM varieties but was very much correlated in CRIS entries. Seed cotton yield was highly and positively correlated with sympodia per plant, number of bolls per plant and boll weight in all cotton varieties. Seed cotton yield and Earliness were uncorrelated with ginning outturn percent. Since CRIS varieties were early maturing and high yielding and more adaptive than CIM entries. Growers have been advised to cultivate CRIS varieties as they would get high yield and vacate the fields early to prepare for coming wheat crop without loss of time.

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