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Original Research Article

ASSOCIATION STUDY OF ASSORTEDYIELD LINKED COMPONENTS IN WHEAT CROSSES BY INVOLVING EXOTIC GENOTYPES

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***Abstract*:** *In the world, Wheat is produced in an area of about two hundred million hectares. The 80% population is growing wheat in Pakistan. The top wheat producing countries Pakistan stands in 10th number. Biotic and abiotic factors, adverse environmental conditions and decline in cultivation area the wheat production decreasing day by day in Pakistan. For increasing the yield, there is a need to develop new wheat lines. For that motive, the present experiment was planned. F_1 generation nine cross combinations (XJ-22×XJ-24, XJ-22×XJ-25, XJ-22×XJ-23, XJ-24×XJ-22, XJ-24×XJ-23, XJ-23×XJ-22, XJ-23×XJ-25, XJ-25×XJ-22, and XJ-25 × XJ-23) were used. The F_1 hybrids compared with the local wheat varieties (Faisalabad 2008, Ujala 2016 and Johar 2016). The selected material was grown with three replications under randomized complete block design during typical sowing date in the field zone of Plant Breeding and Genetics in University of Agriculture, Faisalabad. From the genotypes, yield and yield-related traits were collected, and data was analyzed for yield and yield-contributing parameters using variance analysis and correlation. Among crosses difference was detected by analysis of variance. Study of correlation showed that positive correlation between crosses grains per spike and all yielding features such as grain yield per spike, plant height, peduncle length, spike length, spikelets per spike, thousand grain weight, and tillers per plant and yield per plant except for spike density. The superior crosses and wheat lines can be further used to develop new high yielding wheat varieties in order to obtain high wheat production.*

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Introduction

Wheat is used in many ways like making poridges, suji and breads. The others parameters linked with yield parameter directly and indirectly which is a complex parameter. The work of a breeder is attached with type and amount of association within the parameters. Wheat is roughly used as a food worldwide for one billion community of people (Shahzad *et al*., 2019). It is on the world's top three cereals list, alongside rice, wheat and maize. Wheat is cultivated around the world, on over 200 million hectares. In the world, top ten wheat producing countries Pakistan has an important role in wheat production and produces 80 percent of the population. In 2017-18, the contribution of wheat increased by 9.1 percent to the amount, and in Pakistan, by 1.7 percent to GDP. The area under cultivation decreased during 2017-18 but the wheat yield was nearly the same as in 2016-17. The decline in yield, region and production in 2017-18 (Anonymous, 2015-16) was 1.8 percent, 2.6 percent, and 4.4 percent respectively. It is the second largest cultured species of the *Triticum* genus. Selection of superior parents represents the main step in the production of new high-yielding lines and the maximum identification of superior hybrid. Heterosis makes differences in less production lines and hybrids and the breeder can remove less producing lines from the hybrids. In cross-pollinated crops the heterotic effect is usually more pronounced than in self-pollinated (Gallais, 1988). Evaluation of yield variability and its component characteristics is important before preparing a suitable breeding strategy for genetic improvement. Borghi and Perenzin (1994), and Saini *et al.* (2015) reported earlier heterosis in wheat. Heterosis is the most critical feature of any cultivated hybrid. In genetics, the parameters of genotypical and phenotypical coefficient of genetic variation are useful for the measurement of the amount of heterogeneity present in the germplasm. In predicting the resulting impact in selecting the best genotypes for yield and its attributing characteristics, heritability coupled with high genetic advance will be more useful device. The more adopted parents which have more chances of heterotic F_1 responses and the wider area of segregation variation in all fitness limits. Taking into account the above aspects, the present investigation was conducted to obtain information on parental line genetic variability parameters and to estimate the magnitude of F_1 hybrid heterosis, heterobeltiosis and economic heterosis (Budak and Y niños (1996).

The first aim of wheat production is to maximize grain production; however, yield is a difficult parameter. It is controlled by polygene and changes many genetic and non-genetic factors; therefore, the knowledge about gene action nature is necessary to maximize time of selection. Breeding efforts have resulted in various improved high yielding lines with superior grain characteristics of hexaploid wheat. As breeding stock, different genotypes and advanced lines which have different phenotypical characteristics and economic features are available. Knowledge about identity and size of genetic changes controlling the inheritance of quantitative parameters like production and its component is important for effective genetic development.

Materials and methods

Experiment was conducted for the evaluation of correlation and commercial heterosis estimation of yield components in wheat by using randomized complete block design under triplicate manners in the research area of the Department of Plant Breeding and Genetics, University of Agriculture Faisalabad. In this experiment we used nine crosses of Chinese lines (XJ-22×XJ-24, XJ-22×XJ-25, XJ-22×XJ-23, XJ-24×XJ-22, XJ-24×XJ-23, XJ-23×XJ-22, XJ-23×XJ-25, XJ-25×XJ-22, XJ-25×XJ-23) obtained from the four parents (XJ-22, XJ-23, XJ-24, XJ-25) from the previous season experiment from the department material. The nine crosses and three local varieties sown with 1 meter long row each in three replications. The experiment was sown with the help of dibbler, spacing of 9 inches apart and 6 inches within row. All agricultural practices and precautions including fertilizers, irrigations and plant protection applied uniformly to the experimental population. Plant was selected randomly from the experimental lines and data of following traits was taken.

Plant height (cm)

To measure plant height, the plant's main tiller was selected and measured from ground level to plant spike tip without awn. The calculation was done in centimeters.

Tillers/plant

The marked total number of productive tillers of tagged plants was counted at harvest time, and the mean was measured and used.

Spike length (cm)

At maturity stage the length of the spike from the base to the tip of the spike without awns was assessed. It was measured in centimeters.

Spikelets/spike

The number of spikelets from the plant's main spike excluding the basal sterile spikelets was counted.

Grains/spike

The main plant spike used to take the number of spikelets per spike, this spike was used for counting number of grains.

Peduncle length (cm)

Peduncle length of the plant's main tiller was taken in centimeters (cm) from the upper node of the main tiller to the base of the spike at maturity point, and afterwards we used the mean value of the peduncle length for statistical analysis.

Density of spike

We determined the density of the spike by dividing the number of spikelets per spike by length of spike.

Grain yield/spike (g)

The selected main spike of the plant was taken and manually threshed. Weighing of grains in grams for each spike was achieved using automated electronic balance.

Weight of thousand grains (g)

The sample weight of 1000 grains was taken randomly from the main selected plant and then weight of the grains was measured in grams utilizing digital electronic balance.

Plant yield (g)

All the major plants chosen were harvested and manually threshed. Weighing was achieved by using the electronic digital balance for each plant.

Statistical analysis:

The significance of the data was calculated by using variance analysis for all the parameters according to the Steel et al. (1997) protocol. According to Kown and Torrie (1964) the correlation analysis was calculated.

Results and discussion

It was detected by analysis of variance (ANOVA) that differences were existing among 9 wheat crosses for parameters studied like plant height, peduncle length, length of spike, spike density, grains per spike, spikelets/spike, grain weight per spike, 1000 grain weight, tillers per plant and yield per plant table 1. Correlation is the calculation of ability of relationship occurring among two or more independent variables. In crop breeding strategy, it is used to show the relative importance of different plant parameters. Correlation analysis is measured among morphological parameters is a logical sense. The estimation of phenotypic correlation analysis is the correlation between two plant traits due to phenotypic appearances of the plant. The estimation of genotypic correlation analysis is the analysis between two plant genotypic traits due to genotypic association among the traits. This reveals the contribution of genotypic factors in the development of association.

Correlation between plant heights with other morphological parameters

The correlation between plant height and other traits is a relationship occurring among these traits. In crop breeding method, it is used to show the relative importance of the crop traits. Plant height showed different correlation with different traits like it showed positive and high significant correlation with peduncle length and with thousand grain weight. It is positively and non-significantly correlated with the traits as spike length, spike density, grain yield per

spike and yield per plant. Plant height is negatively correlated with spikelets per spike and grains per spike. It is non-significantly correlated with these traits as showed in the table 2.

Correlation between tillers per plant with other morphological parameters

Tillers per plant correlated with other yield parameters. It showed positive correlation with some traits and it also showed negative correlation with other traits. But it didn't show significant correlation with any of the traits. It showed positive and non-significantly correlated with the spike length, spikelet's per spike, grains per spike, peduncle length and grain yield per spike. It is non-significantly and negatively correlated with spike density, thousand grain weight and yield per plant as showed in table 2.

Correlation between spike length with other morphological parameters

Spike length is an important plant yield trait and it showed correlation with plant parameters. It showed positive and significant correlation with grains per spike. It showed positive but non-significant relation with spikelet's per spike. It showed negative correlation and highly significantly correlated with peduncle length, spike density, thousand grain weight and yield per plant. The other trait like grain yield per spike showed negative and non-significant correlation with spike length as showed in table 2.

Correlation between spikelet's per spike with other morphological parameters

Table 2 showed the correlation between spikelet's per spike and other yield parameters. This parameter is associated with yield indirectly as number of spikelet's increases the grain production increases and maximize the yield. It showed positive and highly significant correlation with grain yield per spike. It also showed negative and non-significant correlation with other yield parameters like plant height, peduncle length, thousand grain weight and yield per plant. It showed positive an non-significant correlation with other yield traits like tillers per plant, spike density and grain yield per spike.

Correlation between grains per spike with other morphological parameters

Grains per spike is an important yield parameter. In table 2, it showed correlation with other yield traits. It showed positive as well as negative correlation with different parameters. It is positive and highly significantly correlated with spikelets per spike. It showed positive and significant correlation with spike length. It showed also negative correlation which is no significant in relation to other traits. It showed negative and non significant correlation with plant height, peduncle length, spike density, thousand grain weight and yield per plant. It also showed positive but non-significant correlation with other yield traits like tillers per plant.

Correlation between peduncle length with other morphological parameters

Peduncle length is important parameter in plant height. It also showed different correlation values in table 2. It showed positive highly significant correlation as well as negative and non-significant correlation with other traits. It showed positive and highly significant correlation with plant height as it plays an important role in plant height. It also showed positive and highly significant correlation with thousand grain weight and yield per plant. It showed significant and positively correlated with spike density. It also showed negative and highly significant correlation with other trait like spike length. It showed positive and non-significant correlation with tillers per plant and grain yield per spike. It also showed negative and non-significant correlation with spikelet's per spike and grains per spike.

Correlation between spike density with other morphological parameters

It showed positive and high significant correlation with thousand grain weight and yield pe plant. This trait also showed positive as well as negative correlation with other parameters. It showed positive and significant correlation with peduncle length. It also showed negative but highly significant correlation with spike length. It showed positive and non-significant correlation with spikelet's per spike and grain yield per spike. It also showed negative and non-significant correlation with tillers per plant and grains per spike as showed in table 2. Similar findings find by Zaazaa*etal.*,(2012)

Correlation between grain yield per spike with other morphological parameters

In yield parameters of plant, grain yield plays an important trait. It directly related with production of the crop. It is correlated with yield traits directly or indirectly to enhance the yield. It also showed positive and negative correlation with plant traits. It showed positive and high significant correlation with thousand grain weight. It also showed positive and significant correlation with grains peer spike. It showed negative and non-significant correlation with spike length. With other remaining traits under study, it showed positive but non-significant correlation like plant height, tillers per plant, spikelet's per spike, peduncle length and with spike density as showed in table 2. These results are similar with findings of Zhao *et al.*,(2015).

Correlation between thousand grain weight with other morphological parameters

Thousand grains weight is important yield parameter and it is correlated with other yield traits directly or indirectly. It also showed positive and negative correlation with yield traits. In table 2, it showed positive and highly significant correlation with plant height, peduncle length, spike density, grain yield per spike and yield per plant. It also showed negative but highly significant correlation with yield trait like spike length. On other side, it also showed negative and non-significant correlation with other plant traits

like tillers per plant, spikelet's per spike and grain per spike. These results are similar with findings of Sud *et al*. (2010).

Correlation between yield per plant with other morphological parameters

In table 2, yield per plant showed correlation with other studied traits of the plant. It showed positive as well as negative correlation with traits. it showed positive and highly significant correlation for the peduncle length, spike density and thousand grain weight. It also showed negative but highly significant correlation with spike length. It showed positive and non-significant correlation with plant height and grain yield per spike. This parameter also showed negative and non-significant correlation with other remaining traits like tillers per plant, spikelet's per spike and grains per spike. These results are similar with findings of Beche*et al*. (2013).**Table 1:Mean square ANOVA for traits studied in wheat genotypes using RCBD design**

Sources of variation	Plant Height	ilers per plant	Length of Spike	Spikelets per spike	Grains per spike	Peduncle length	Spike density	Grain yield per spike	1000 grain weight	Yield per plant
Replication	18.0	2.0	3.9	2.3	49.3	1.7	0.03	0.06	18.1	2.07
Genotypes	202.5**	12.1**	9.1**	3.4**	127.1	36.9**	0.03**	1.4**	113.7**	152.9**
Error	6.8	3.1	0.7	1.0	72.8	1.4	0.0	0.4	3.9	0.5
Total										

Table 2:Correlation between different Morphological parameters of Wheat

	Plant Height	Tillers per Plant	Spike Length	Spikelets per Spike	Grains per Spike	Peduncle Length	Spike Density	Grain Yield per Spike	Thousand Grain Weight
Tillers per Plant	-0.0146								
Spike Length	0.0062	0.1341							
Spikelets per Spike	-0.2948	0.2954	0.2734						
Grains per Spike	-0.0472	0.2904	0.393*	0.6742**					
Peduncle Length	0.7732**	0.0508	-0.445**	-0.2269	-0.0928				
Spike Density	0.2151	-0.2713	-0.675**	0.0656	-0.1346	0.3703*			
Grain Yield per Spike	0.2304	0.1232	-0.1409	0.1843	0.3915*	0.301	0.2735		
Thousand Grain Weight	0.562**	-0.1598	-0.659**	-0.1806	-0.1386	0.7756**	0.7082**	0.4702**	
Yield per Plant	0.2926	-0.086	-0.832**	-0.2657	-0.2482	0.7109**	0.5285**	0.3211	0.8341**

Conclusion

Correlation analysis in the plant breeding shows the relative importance of different plant parameters, which can be important in a crop breeding programs. Grains per spike showed positive correlation with above stated all parameters except with spike density showed negative correlation. Grain yield per spike showed positive and highly significant correlation with grains per spike and spikelets per spike and positively correlated with all other parameters. Plant height showed positive correlation and high significantly correlated with peduncle length. It was significantly correlated with thousand grain weight, tillers per plant and yield per plant and negatively correlated with spike length. Peduncle length showed positive and highly significant correlation with plant height and significantly correlated with thousand grain weight, yield per plant and negatively correlated with spike length. Spike density showed positive and highly significant correlation with thousand grain weight, yield per plant and negative correlation with tillers per plant and spike length. Spike length showed highly significant and positive correlation with spike density and negative correlation with thousand grain weight and yield per plant. It showed negative correlation with plant height. Spikelets per spike showed positive correlation and highly significantly correlated with grains per spike. It showed significant correlation with grain yield per spike and positively correlated with other parameters. Thousand grain weight showed highly significant and positive correlation with yield per plant but highly significant negative correlated with spike length and positively correlated with other parameters. Tillers per plant showed negative correlation with spike density, thousand grain weight, yield per plant and positively correlated with all other parameters. Yield per plant showed positive and highly significant correlation with spike density, thousand rain weight. It showed negative but highly significant correlation with spike length and showed negative correlation with tillers per plant and positively correlated with all other traits.

Conflict of interest

The authors declared absence of conflict of interest.

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