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CORRELATION STUDIES OF SOME QUALITATIVE AND QUANTITATIVE TRAITS WITH GRAIN YIELD IN SPRING WHEAT ACROSS TWO ENVIRONMENTS

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A 8x8 complete diallel population was studied to estimate correlation coefficients of seven quality and morphological traits in wheat. Sowing was done on 15th November and 15th December 2007-08. The differences among all the traits were statistically significant. Grain yield per plant under normal planting was significantly and positively correlated with plant height, peduncle length and 1000-grain weight. It was also positively correlated with spike length and gluten at genotypic level at P≤0.01. Only grain yield per plant was negatively and significantly correlated with protein under both planting dates at genotypic level. Genotypic correlation of grain yield per plant in case of late planting was positive and non-significant with plant height, peduncle length and spike length, while it was negatively correlated with gluten. Phenotypic correlation of grain yield per plant with plant height, peduncle length, spike length, 1000-grain weight and gluten was positive and significant under both plantings while grain yield per plant was negatively and significantly associated with protein. It is therefore suggested that 1000-grain weight, peduncle length and gluten should be given more emphasis to improve yield and quality in wheat.

Keywords: Spring wheat, correlation, environments

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important food crop of Pakistan. Wheat yield fluctuates widely as a result of its interaction with environment due to its complex inheritance and product of several contributing factors. Late planting of wheat in Pakistan, is the most important yield limiting factor. Bajwa *et al.* (1987) reported 11-70% reduction in grain yield due to late planting. Subhani *et al.* (2000) observed positive and significant correlation of grain yield with peduncle length, spike length and 1000-grain weight. Kashif and Kahliq (2004) studied correlation in diallel cross and found positive correlation of grain yield with plant height, spike length and 1000-grain weight at both levels. Muhammad *et al.* (2008) calculated association among yield components in bread wheat. Genotypic correlation of plant height, 1000 grain weight was positive and significant with grain yield under normal and late planting, respectively. Phenotypic correlation revealed that plant height and 1000-grain weights were also positive and significant with grain yield under normal and late planting (Muhammad *et al*., 2008). In wheat quality, protein and gluten are most important traits however less research work has been done in quality traits. Sial *et al.* (2005) recorded high protein in wheat grain in late planting. Muhammad *et al.* (2005) reported positive and significant association between protein and gluten contents at genotypic level. Liu *et al.* (2003) also reported importance of quality traits for bread making.

The aim of present study was to estimate relationship between different quality and yield related parameters in spring wheat under normal and late planting. Present study will be helpful to guide the wheat breeders in their breeding programs.

MATERIALS AND METHODS

The present study involved eight wheat genotypes viz. Shafaq-06, Bhakkar-02, Fareed-06, Sehr-06, 032862, 033010, Panjnad-01 and Manthar-03, were sown during 2006-07 in field of Plant Breeding and Genetics, University of Agriculture Faisalabad, Pakistan. Crossing of the varieties was performed during February/March 2007. Whereas, the parent varieties were allowed to be self pollinated to maintain the true to type seed. At the time of harvesting, crossed spikes were individually harvested/threshed to obtain F_1 seed.

The seed of 8x8 parent diallel (28 direct and 28 reciprocal crosses) along with their parents were sown on two different dates viz. 15th November and 15th December, 2007-08 to raise F_1 generation. Randomized complete block design was followed in the experiment having three replications. Each treatment comprised of a two rows of three-meter length in each replication. Row to Row and plant to plant distances were kept as 30cm and 20cm, respectively.

Ten guarded (plants with equal distance) plants were selected randomly and data were collected on plant height (cm), spike length (cm), 1000-grain weight (g), grain yield per plant (g), analysis of quality parameters (Protein % and Gluten %) were conducted at Wheat Lab WRI, Faisalabad.
To ascertain the significance of data**,** the analysis of variance for all the characters was determined using the technique reported by Steel *et al.* (1997). The correlation coefficient analysis at both genotypic and phenotypic levels was computed according to the method proposed by Kwon and Torrie (1964) then explained by Singh and Chowdhry (1985).

RESULTS AND DISCUSSION

The analysis of variance for plant height, peduncle length, spike length, 1000-grain weight, grain yield per plant, grain protein and gluten % in spring wheat under normal and late sown conditions was carried out. The mean squares from analysis of variance given in Table 1 indicated that genotypic differences were significant (P≤0.01 & 0.05) for all the parameters studied. The relationships among different plant characters are discussed here.

Genotypic correlation coefficients:

***Grain yield per plant*:** Grain yield per plant under normal sown conditions was positively and significantly correlated with plant height, peduncle length, 1000-grain weight while it was positively and non-significantly associated with spike length and gluten. There was negative and significant association between grain yield/plant and grain protein in normal planting. In late planting, genotypic correlation of grain yield per plant was positive and significant with 1000-grain weight, while it was positively and non-significantly associated with plant height, peduncle length and spike length, was negative and non significant interrelationship with gluten in late planting. Kashif and Khaliq (2004), Muhammad *et al.* (2008) also reported similar results**.**

***Plant height*:** With respect to normal planting, positive and significant genotypic correlation of plant height was observed with peduncle length, spike length, 1000- grains weight, gluten and grain yield per plant, negative correlation was recorded with grain protein. Under late planting, plant height had positive relationship with spike length, 1000 grain weight and grain yield per plant. Negative and significant association of plant height was recorded only with peduncle length, negative and non-significant

Table 1. Analysis of variance of the different traits under normal and late sown conditions

Character	Mean Squares					
	Replication		Genotypic		Error	
	Normal	Late	Normal	Late	Normal	Late
Plant height (cm)	0.20 ns	18.15 **	18.88 **	39.02**	3.68	2.97
Peduncle length (cm)	1.76 ns	1.08 ns	11.56 **	14.62**	4.34	0.70
Spike length (cm)	0.44 ns	0.09 ns	1.50 **	2.29**	0.40	0.15
1000-grain weight (g)	0.09 ns	1.51 ns	20.00 **	17.00**	0.37	0.78
Grain yield per plant (g)	1.03 ns	1.73 ns	12.92 **	11.25**	0.96	1.40
Grain protein (%)	0.48 ns	0.31 ns	1.59 **	4.04**	0.40	0.65
Gluten (%)	1.12 ns	4.11 ns	14.61 **	3.99*	0.71	2.78

** = Highly significant at P < 0.01, * = Significant at P < 0.05 , ns = Non-significant at P >0.05

Table 2. Genotypic Correlation matrix (Normal & Late Planting)

Traits		Peduncle length	Spike length	1000, grain weight	Protein (%)	Gluten (%)	Grain Yield/plant
Plant Height	r(g) N	0. 97*	0.85 *	0.55 *	-0.74	0.72 *	0.70 *
	L	- 0.66 *	0.72	0.44	-0.26	-0.47	0.19
Peduncle length	r(g) N		0.74 *	0.50	0.66	0.66 **	0.37 *
	L		0.65	0.88**	-0.62 *	-0.49	0.56
Spike Length	r(g) N			0.59 *	-0.40	0.72	0.44
	L			0.61*	-0.46	-0.21	0.39
1000, grain	r(g) N				-0.57	0.90 *	0.54 *
weight	L				-0.63*	-0.50	0.54*
Protein (%)	r(g) N					0.62 *	-0.98**
	L					-0.41	-0.96**
Gluten (%)	r(g) N						0.62
	L						-0.41

** = Significant at 1% level , * = Significant at 5% level

relationship was found with protein and gluten. Similar results were also reported by the earlier researchers like, Khan *et al.* (1999), and Kashif and Khaliq (2004) also reported positive genotypic correlation between plant height and grain yield.

***Peduncle length*:** At genotypic level, Peduncle length in normal planting was positively and significantly associated with spike length and gluten, positively and non-significantly correlated with 1000-grain weight and protein. While in case of late planting, peduncle length was strongly associated with 1000-grain weight, positively and non-significantly correlated with spike length. While it was negatively and significantly associated with grain protein and negatively and non-significantly associated with gluten (Table 2).

***Spike length*:** In normal planting, spike length was positively and significantly correlated with 1000-grain weight and grain yield per plant at genotypic in normal planting. Negative correlation was found between spike length and protein at both levels. In late sown condition, only positive correlation of spike length was recorded with grain yield per plant and 1000-grain weight at genotypic level (Table 2).

***1000-grain weight*:** In normal sown conditions, 1000-grain weight was positively and significant correlated with grain yield per plant and gluten, and negative association was observed with grain protein. Under late planting, this trait showed positive and strong correlation with grain yield per plant and negatively significant correlation was found with grain protein. 1000-grain weight was negatively associated with gluten. Muhammad *et al.* (2008), found positive correlation of 1000-grain weight with grain yield per plant under both normal and late sown conditions. Dogan (2008) obtained positive correlation of 1000-grain weight with grain yield per plant.

***Grain Protein*:** Grain protein under normal planting was positively and non-significantly correlated with peduncle length while it was negatively correlated with plant height, spike length and 1000-grain weight. Protein was negatively and significantly associated with grain yield per plant under both planting. Significant and positively correlation was recorded in normal planting, negative and non-significant in late planting (Table 2).

***Gluten*:** In case of normal planting, gluten was positively and significantly correlated with protein, while in case of late planting it had negative and non-significant association with protein. Liu *et al*. (2003) and Muhammad *et al.* (2005) reported similar results (Table 2).

Phenotypic correlation coefficients:

***Grain yield per plant*:** Phenotypic correlation matrix (Table 3) revealed that grain yield per plant was strongly and positively associated with plant height, peduncle length, spike length, 1000-grain weight and gluten in normal planting, while it was significantly and negatively associated with grain protein under both plantings. In case of late planting there was positive and significant association between the trait and peduncle length, spike length and 1000-grain weight. Only positive correlation was recorded for grain yield per plant with plant height and gluten in late planting. Akram *et al.* (2008) and Subhashchandra *et al.* (2009) also found similar results.

***Plant height*:** At phenotypic level, positive and strong association was recorded for plant height in normal planting, with gluten, grain yield per plant, peduncle length, spike length, and 1000-grain weight. Its negative correlation was obtained with protein under both plantings (Table 3). Under late sown conditions correlation coefficients, at phenotypic level were computed. Positive and strong association of plant height was recorded with spike length and 1000-grain weight. Only positive correlation was found between plant height and grain yield per plant in late planting. Negative and significant relationship of plant height was found with peduncle length. Plant height in late sowing was negatively

Table 3. Phenotypic Correlation matrix (Normal & Late sowing)

Traits		Peduncle length	Spike length	1000, grain weight	Protein (%)	Gluten (%)	Grain Yield/plant
Plant Height	r(p) N	0.80**	0.43 **	0.40 **	-0.43	0.50 **	0.44 **
	L	-0.54**	0.60**	0.38**	-0.17	-0.17	0.12
Peduncle length	r(p) N		0.30 **	0.32 **	- 0.28 **	0.37 **	0.41 **
	L		0.52**	0.75**	-0.74**	-0.21*	0.43**
Spike Length	r(p) N			0.47 **	-0.32 **	0.43	0.47 **
	L			0.59**	-0.33**	-0.03	0.28**
1000, grain	r(p) N				-041 **	0.80	0.51 **
weight	L				-0.51**	0.02	0.48**
Protein (%)	r(p) N					0.44 **	-0.75**
	L					-0.06	-0.89**
Gluten (%)	r(p) N						0.53**
	L						0.17

** = Significant at 1% level , * = Significant at 5% level

associated with grain protein and gluten. Subhani *et al.* (2000) reported positive and significant correlation between grain yield per plant and plant height at phenotypic level. Saleem *et al.* (2006) reported its positive correlation with 1000-grain weight, spike length and grain yield at phenotypic level.

***Peduncle length*:** Peduncle length under normal and late sown conditions had positive and significant phenotypic correlation with spike length, 1000-grain weight and grain yield per plant. Phenotypic correlation between plant height and gluten was positive and significant in normal planting and negative in late plating. . Peduncle length was found negatively and significantly associated with grain protein in both sowing dates.

***Spike length*:** In both plantings, phenotypic correlation of spike length was positive and significant with 1000-grain weight and grain yield per plant. It was positively correlated with gluten in normal planting and negative associated in late planting. The trait at phenotypic level was negative and significant with grain protein in both plantings. Earlier Subhani *et al.* (2000), Saleem *et al.* (2006) and Subhashchandra *et al.* (2009) also reported similar results.

***1000-grain weight*:** Phenotypic correlation coefficient of 1000-grain weight was recorded as strong and positive with plant height, peduncle length, spike length and grain yield per plant in both plantings. Positive phenotypic correlation was found between 1000-grain weight and gluten in both cases. The trait, 1000-grain weight had strong and negative association with grain protein in both conditions (Table 3). Dogan (2008) also found positive correlation of 1000-grain weight with grain yield per plant.

***Grain protein*:** Phenotypic correlation of grain protein in both plantings was recorded as negative and significant with peduncle length, spike length, 1000-grain weight and grain yield per plan. Grain protein in normal planting was positive and significant with gluten at phenotypic level. In case of late planting, it was negatively correlated with gluten at phenotypic level. Liu *et al.* (2003) found similar results and reported positive correlation between protein and gluten.

***Gluten*:** There was positive and significant association between gluten and plant height, peduncle length, protein and grain yield per plant in normal sowing, negative and significant with peduncle length in late planting. The trait gluten was positively associated with spike length, 1000-grain weight and grain yield per plant in late planting (Table 3).

CONCLUSION

A highly significant difference was observed in almost all the traits under normal and late sown conditions which indicated that diverse type of genetic material was used for such studies. It is also suggested that 1000-grain weight, peduncle length and gluten should be given more emphasis to improve grain yield in wheat

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