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Association of Morphological Traits with Grain Yield in Wheat (*Triticum aestivum* L.)

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ABSTRACT

Interrelationships between yield and its components for wheat were determined by correlation and path coefficient analysis. All the traits except grain weight per spike were correlated positively and significantly both at phenotypic and genotypic levels. Path coefficient analysis showed that number of grains per spike had maximum direct effect on grain yield per plant followed by grain weight per spike in wheat. 1000-grian weight had negative direct effect on grain yield per plant. From the present studies it could be concluded that indirect selection based on spikelets per spike, number of grains per spike and/or grain weight per spike would contribute significantly to develop high yielding wheat genotypes.

Key Words: Morphological traits; *Triticum aestivum* L.; Grain yield; Correlation coefficient; Path analysis

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important food grain in the world and staple food of the people of Pakistan. It is annually cultivated on an area of 8.070 million hectares with production of 19.157 million tonnes (Govt. of Pakistan, 2001-2002). It plays a vital role in stability of the economy of Pakistan. Grain yield is a product of an organized interplay of several factors, which are highly susceptible to environmental fluctuations. However, yield can be estimated on the basis of performance of yield components. Yield is a complex character dependent upon the interaction of environment and genetic makeup of the wheat plant. Apart from direct selection for grain yield, enhancement in most situations is more effectively fulfilled on the basis of performance of yield components, which are closely associated with grain yield. Correlation analysis provides information about association of plant characters and therefore, leads to a directional model for yield prediction. Path coefficient analysis quantifies the interrelationships between different components in their direct and indirect effects on grain yield. Investigations made by Singh and Singh (1999, 2001) and Aruna and Raghaviah (1997) indicated that there is a positive and significant association between grains per spike and grain weight with yield. Number of spikelets per spike were also positively and significantly correlated with grain yield. However Chowdhry *et al.* (2000) reported that there was positive but non-significant correlation between spikelets per spike and 1000-grain weight both at genotypic and phenotypic levels. Numbers of grains per spike has direct positive effects and indirect effect via number of spikelets per spike (Nabi *et al.*, 1998). According to Mohy-ud-Din (1995) and Shoran *et al.* (2000) 1000-grain weight has a negative direct effect on grain yield while positive indirect effects was observed via number of grains per spike and grain weight per spike.

MATERIALS AND METHODS

These studies were carried out in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The experimental material consisted of fifteen varieties /lines of spring wheat viz. FD-83, FD-85, Pb-85, Pb-96, Inqilab-91, Wattan, Uqab-2000, 4072, 4770, 4943, 5039, 6142, 6145, 6529-11 and 6544-6. The varieties/lines were planted in the field according to a randomized complete block design with three replications. Three lines per variety/line were planted in each replication. Seeds were sown with the help of dibble maintaining row to row distance of 30 cm and plant to plant distance of 15 cm. All agronomic practices were kept uniform. At maturity ten guarded plants from each replication were taken for recording the data on number of spikelets spike, number of grains per spike, grain weight per spike (g), 1000-grain weight (g) and grain yield per plant (g).

The analysis of variance and covariance for all above mentioned traits was performed according to Steel and Torrie (1980). Correlation matrix was prepared following the formulae given by Kwon and Torrie (1964) and path coefficient analysis was done according to Dewey and Lu (1959).

RESULTS AND DISCUSSION

Mean differences among 15 varieties/lines for five traits were highly significant (Table I). Phenotypic and genotypic correlations for all possible combinations are presented in Table II. Genotypic correlation was higher than the phenotypic correlation in all the traits studied.

Correlation. The relationship between the number of spikelets per spike had positive and highly significant correlation with number of grains per spike and grain yield per plant at phenotypic level and positive significant correlation at genotypic level (Table II). The results are in

Table I. Mean square and mean values for different traits in wheat (*Triticum aestivum* L.)

SOV	D.F.	Number of spikelets per spike	Number of grains per spike	Grain weight per spike	1000 grain weight	Grain yield per plant
				Mean Squares		
Replication	2	0.642	0.028	0.015	0.940	0.175
Genotypes	14	0.637**	1.524**	0.394**	7.691**	0.143**
Error	28	0.103	0.112	0.025	1.024	0.048
				Mean Values		
Genotypes						
FD-83		19.83 def	52.03 gh	1.13 g	33.67 e	17.60 e
FD-85		20.07 bcdef	53.57 ab	2.06 abcd	37.30 abc	18.03 abcd
Pb-85		20.33 bcd	52.70 def	1.96 cd	36.40 bcd	18.03 abcd
Inqilab-91		19.87 cdef	51.30 i	1.43 f	33.97 e	17.67 de
Pb-96		20.67 b	54.00 a	2.20 abc	38.67 a	18.20 ab
Wattan		19.57 ef	52.60 defg	2.33 a	37.40 abc	18.00 abcde
Uqab-2000		20.17 bcde	52.90 cde	2.30 ab	38.67 a	18.20 ab
4072		20.07 bcdef	52.73 def	2.23 abc	37.50 ab	18.10 abc
4770		19.53 f	51.80 hi	1.66 ef	36.50 bcd	17.87 ab
4943		20.47 bc	53.07 bcd	2.00 bcd	37.37 abc	18.27 ab
5039		20.10 bcdef	52.37 efgh	1.80 de	35.47 cde	17.93 bcde
6142		21.33 a	52.83 cde	2.09 abcd	37.33 abc	18.37 a
6145		20.27 bcd	53.37 bc	2.33 a	36.47 bcd	18.07 abcd
6529-11		19.80 def	52.17 fgh	1.53 ef	34.27 e	17.73 cde
6544-6		20.50 b	52.00 gh	2.13 abc	35.00 de	17.97 abcde

Table II. Phenotypic (P) and genotypic (G) correlation coefficients of traits in wheat (*Triticum aestivum* L.)

Variables		No. grains per spike	Grain weight per spike	1000 grain weight	Grain yield per plant
Number of spikelets per spike	P	0.4685**	0.3889*	0.3559n.s	0.7209**
	G	0.5462*	0.4313n.s	0.4365n.s	0.8452*
Number of grains per spike	P		0.6702**	0.7639**	0.7189**
	G		0.6980*	0.8686*	0.8835*
Grain weight per spike	P			0.8120*	0.8082*
	G			0.9363*	0.9547*
1000 grain weight	P				0.72589**
	G				0.97879*

* = Significant at 5% level of probability; ** = Highly Significant at 1% level of probability; n.s = Non-significant

Table III. Path coefficient and correlation coefficient analysis of grain yield per plant VS different yield traits studied in Wheat (*Triticum aestivum* L.)

Variables	Number of spikelets per spike	Number of grains per spike	Grain weight per spike	1000 grain weight	Correlation coefficient (rg)
Number of spikelets per spike	0.52707	2.34019	1.5501	-1.1936	0.84523
Number of grains per spike	0.28789	4.28441	2.50851	-2.3752	0.88348
Grain weight per spike	0.22734	2.99055	3.59381	-2.5602	0.95471
1000 grain weight	0.23006	3.72153	3.3647	-2.7345	0.97879

good agreement with the findings of Mohy-ud-Din (1995) and Singh and Singh (1999). Similarly phenotypic and genotypic correlation between number of spikelets per spike and grain weight per spike was observed positive and significant at phenotypic level and positive but non-significant at genotypic level (Aruna & Raghaviah, 1997). Association between number of spikelets per spike and 1000-grain weight was positive but non-significant both at genotypic and phenotypic levels. Chowdhry *et al.* (2000) also reported similar type of association among these traits.

There was positive and highly significant correlation between numbers of grains per spike with grain weight per spike, 1000-grain weight and grain yield per plant at phenotypic level and positive significant correlation at genotypic level. Gupta *et al.* (1999) and Singh and Singh (2001) reported similar trends for these traits. Association of grain weight per spike with 1000 grain weight and grain yield per plant was positive and significant both at phenotypic and genotypic levels. The results also showed (Singh & Singh, 2001). Positive and highly significant correlation between 1000-grain weight and grain yield per plant at phenotypic level and positive significant correlation at genotypic level. These results are corroborated by the earlier findings of Shoran *et al.* (2000).

Path coefficient analysis. Direct effect of number of spikelets per spike on grain yield per plant was positive (Table III). Number of spikelets per spike had positive indirect effect via number of grains per spike and grain weight per spike and negative indirect effect via 1000-grain weight on grain yield per plant (Mohy-ud-Din, 1995). Direct effect of number of grains per spike on grain yield per plant was positive. Number of grains per spike had positive indirect effect via number of spikelets per spike, grain weight per spike and negative indirect effect via 1000-grain weight on grain yield per plant (Nabi *et al.,* 1998). Direct effect of grain weight per spike on grain yield per plant was positive. Grain weight per spike had positive indirect effect via number of spikelets per spike, number of grains per spike and negative indirect effect via 1000-grain weight on grain yield per plant. The earlier findings of Aruna and Raghavaiah (1997) also supported these results. Direct effect of 1000-grain weight on grain yield per plant was negative while 1000-grain weight had positive indirect effect via number of spikelets per spike, number of grains per spike and grain weight per spike on grain yield per plant. The findings of Chowdhry *et al.* (2000) and Shoran *et al.* (2000) confirmed the present results. Thus selection on the basis of number of grains per spike, grain weight per spike and number of spikelets per spike in this material would likely to be most useful for increasing grain yield in practical wheat breeding programme because of their direct positive contribution to grain yield.

CONCLUSION

Grain yield per plant can be improved by selecting genotypes having more number of spikelets per spike, number of grains per spike and grain weight per spike. The genotypes used in the present study can be used to obtain different combinations of these traits for high yielding segregants.

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