Pak. J. Bot., 43(1): 165-170, 2011.

COMPARATIVE STUDY OF MORPHOLOGICAL TRAITS IN WHEAT AND TRITICALE

FIDA MOHAMMAD[1*], IJAZ AHMAD[1], NAQIB ULLAH KHAN[1], KHURRAM MAQBOOL[1], AYSHA NAZ[1], SALMA SHAHEEN[2] AND KHALID ALI[3]

[1]*Department of Plant Breeding & Genetics, KP Agricultural University, Peshawar, Pakistan*
[2]*Department of Soil and Environmental Sciences, Gomal University, D.I.Khan, Pakistan*
[3]*Agriculture Research Institute, Tarnab, Peshawar, Pakistan*

Abstract

Triticale (*Triticosecale*), a new man made cereal, is known to be more drought tolerant and high yielding. An experiment comprising eight genotypes each of wheat and triticale was conducted at the Khyber Pakhtunkhwa Agricultural University Peshawar during 2002-2003. The experiment was planted in a Randomized Complete Block Design (RCBD) with two replications. Data were collected on plant height, spikelets spike^{-1}, spike length and harvest index. Data for all the traits were statistically analyzed. All genotypes were observed to be significantly different for plant height, spikelets spike^{-1} and spike length but non-significantly different for harvest index. Heritability estimates for plant height, spikelets spike^{-1} and spike length were 90%, 98% and 84%, respectively. Significant genotypic and phenotypic correlations were detected between plant height with spike length and spikelets spike^{-1}, while non-significant correlations were found between spikelets spike^{-1}, spike length and plant height. Morphologically, triticale appeared to be better than wheat, but the experiment needs to be repeated for getting more explicit conclusions.

Introduction

Wheat is the most important cultivated crop that ranks first in acreage as well as production amongst all the cereals in Pakistan and all over the world. Population pressure urges food security. Due to importance of wheat as a leading food crop in the farming system, many plant breeders are engaged in its improvement throughout the world. There has been an extensive research to pyramid such morphological traits that could partition adequate portion to grain yield resulting in high grain yield. As the Khyber Paktunkhwa province comprises several ecological zones with different climates, the existing wheat cultivars are not giving us good yield because of inadequate moisture availability and an erratic distribution of rain in the province.

Triticale (*Triticosecale* Wittmack) is a potential cereal to give better yield under moister stressed condition. It exhibited better performance than wheat regarding yield, plant height and other characters with very high level of resistance to wheat diseases. All these evidences prove that triticale can compete with the long established cereal crop like wheat in many situations including drought. Yield could be increased through selection of plants with taller plant height and more spikelets spike^{-1} (Zaheer, 1991). It can be hoped that triticale will exceed wheat in performance, due to its superior plant height, spikelets spike^{-1}, spike length and harvest index

Triticale is a new crop in this region and thus needs to be researched in multi-directions before recommended for commercial cultivation. The objectives of this study were to: i) study the genotypic performance of triticale in comparison with wheat under the agro-climatic conditions of Peshawar valley, ii) determine genotypic and phenotypic correlations among yield related traits, and iii) determine heritability for yield and its associated traits.

[*]E-mail: fida270463@yahoo.com

Materials and Methods

The experiment was conducted in the Department of Plant Breeding and Genetics, Khyber Pakhtunkhwa Agricultural University Peshawar, Pakistan in the year 2002-2003. Eight genotypes of triticale from CIMMYT (ITYN 2001) and eight cultivars of wheat were compared. The experiment was laid out in a Randomized Complete Block (RCB) Design with two replications. Each plot consisted of 5 rows with row length of 3 m and row to row distance of 30 cm. Seed rate for each plot was calibrated at the rate of 100 kg ha^{-1}. Nitrogen and phosphorus were applied at the rate of 64 kg ha^{-1} and 50 kg ha^{-1}, respectively. Data were recorded on plant height, spikelets $spike^{-1}$, spike length and harvest index.

Height of the main tiller was recorded from the ground level to the tip of spike excluding awns on 5 randomly selected plants at maturity. Spike length of 5 randomly selected spikes was measured from the base of first spikelets to the tip of terminal spikelets excluding awns at maturity. Plants from the three central rows were harvested and weighed for biological yield. Harvest index was computed from the available data of grain yield and biological yield, using following formula:

$$HI(\%) = \frac{Grain\ Yield\ Plant^{1}}{Biomass\ Plant^{1}(kg)} \times 100$$

Data were analyzed using Mstatc statistical package and orthogonal contrast was applied to test the significance of treatment difference. Individual analysis of variance on each wheat and triticale genotypes were conducted where the two groups were declared significant. Phenotypic and genotypic correlation coefficients were estimated, using the same package. Heritability estimates were calculated from variances among inbred line (Hallauer & Miranda, 1981).

Results and Discussion

Plant height: Mixed genotypes showed highly significant difference ($p \leq 0.01$) for plant height (Table 2), which is supported by Maqbool *et al*., (2003), Mohammad *et al*., (2004) and Rafiullah *et al*., (2007). Orthogonal contrast between wheat and triticale genotypes was highly significant for plant height. The comparative data of wheat and triticale revealed that triticale had a wider range of plant height. Non-significant difference was observed within wheat and triticale genotypes (Table 2). In contrary to our findings, Ahmad *et al*., (2003), Mohammad *et al*., (2001) and Akbar *et al*., (2000) reported significant differences in wheat. One of the possible reasons could be that elite breeding lines were included in the study which resulted in the narrow genetic differences for this trait. Plant height for mixed genotyped ranged between 80.5 and 124.8 cm with a mean value of 102.87 cm (Table 3). Plant height for triticale genotypes ranged between 108.4 cm and 125 cm with a mean value of 115.2 cm (Table 3). Wheat genotypes ranged from 80.5 cm to 110 cm with a mean value of 91 cm (Table 3). Heritability estimate for this parameter was found to be 90% (Table 3). The high heritability for this trait indicates that a few genes may control the character under consideration and that it is qualitatively inherited. Results of this study are in conformity with the findings of Rahman & Kronstad (1991) who reported high heritability for this trait in wheat. Contrary to our findings, Shah *et al*., (2003) reported a negative correlation between plant height and harvest index. This may be due to the difference of plant materials, used in each experiment. Non-significant genotypic and phenotypic correlations were observed in separate analysis for wheat and triticale genotypes for plant height with spike length, spikelets $spike^{-1}$ and harvest index (Table 4).

Table 1. Cultivar/lines of triticale and wheat used during 2002-2003.

S. No.	Parentage	Pedigree
	Wheat	
1.	Tatara	Released by NIFA
2.	Pirsabak-85	Released by CCRI
3.	Ghaznavi-98	Released by Agril. Univ. Peshawar
4.	Dera-98	Released by ARI (D.I. Khan)
5.	Takbeer	Released from ATTILLA
6.	Fakhr-e-Sarhad	Released by NIFA
7.	Inqalab-91	Released by Ayub Agri. Res. Station, Faisalabad
8.	Chanab	Released by Ayub Agri. Res. Station, Faisalabad
	Triticale	
1.	Pollmer_2.1.1	CTY88.547-22RES-IM-0Y-2M=1Y-0M-1B-0Y
2.	ARDI_1.TOPO 1419//ERIZO_9/3/2*KISSA_7-1	CTSS92B00490M-B-1M-1Y-0Y-0B
3.	LIRA/BUC/4/2*T4466/3/K760/DP//X77-387-1/5/LIRON_2/6/LIRON_1/7/CAAL	CTIB0009S-10Y-0Y-0B
4.	LIRA/BUC/4/2*T4466/3/L760/DP//X77-387-1/5LIRON_2/6/LIRON_1/7/CALL	CTIB93Y00071T-4B-1Y-0Y-0B
5.	LIRA/BUC/4/2*T4466/3/K760/DP//77-387-1/5/LIRON_2/6/LIRON_1/7/ ERIZO_11/YOGUI_3	CTIB93Y00070T-10B-4Y-0Y-0B
6.	NIMIR_3ERIZO_12/5GC.3/733.3/733.EB// MPE/3/LAMB_3/4/BUF_2/6/POLLMER_2	CTSS92B00849T-D-1Y-0Y-0B
7.	PFT80413/DLE//ZEBRA79/3/GNU_5/4/ KER_2/5/MANATI_1	CTSS92B00192S-25Y-0Y-0B
8.	RA64/SONNI_4/3/HARE_132/ CIVET//STIER_28	CTSS92B00953T-C-1M-1Y-0Y-0B

Table 2. Mean squares for plant height (PH), spikelets spike^{-1} (SLPS), spike length (SL) and harvest index (HI) of wheat and triticale during 2002-2003.

Crops	Mean squares			
	PH	SLPS	SL	HI
Wheat	40.31	1.06	0.75**	30.16
Triticale	48.25	2.85	0.34	8.10
Mixed experiment	327.05**	45.63**	1.94**	20.51

Table 3. Means and ranges of plant height (PH), spikelets spike^{-1} (SLPS), spike length (SL) and harvest index (HI) of wheat and triticale during 2002-03.

Traits	Wheat		Triticale		Mixed Experiment	
	Mean	Range	Mean	Range	Mean	Range
PH	91^{NS}	81-110	115^{NS}	108-125	102**	81-125
SL	11**	10-12	13^{NS}	12-14	12**	10-14
SLPS	18^{NS}	17-20	28^{NS}	25-30	23**	17-30
HI	15^{NS}	5-28	14^{NS}	5-21	20^{NS}	5-28

Table 4. Phenotypic and genotypic correlations coefficients among plant height (PH), spike length (SL), spikelets spike^{-1} (SLPS) and harvest index (HI) during 2002-2003.

Traits	Wheat		Triticale		Mixed Experiment	
	r_g	r_p	r_g	r_p	r_g	r_p
PH VS SL	0.692*	0.256	0.523	0.228	0.899**	0.732**
PH VS SLPS	-.210	-0.293	0.464	0.401	0.922**	0.836**
PH VS HI	-0.397	-0.030	-0.286	-0.082	-0.370	-0.165
SL VS SLPS	0.173	0.426	-0.194	-0.051	0.840**	0.801**
SL VS HI	-0.070	-0.092	-0.597	-0.370	-0.350	-0.253
SLPS VS HI	0.785**	0.510*	0.224	0.045	-0.196	-0.101

Spikelets spike^{-1}: Highly significant differences ($p \leq 0.01$) were observed in mixed genotypes showing diverse types of wheat and triticale genotypes (Table 2) which is supported by Ahmad *et al*., (2003) & Khan *et al*., (2001). Spikelets spike^{-1} was highly significant between wheat and triticale genotypes as shown by orthogonal contrast. In the present study triticale exhibited more spikelets spike^{-1} than wheat. Non-significant differences ($p<0.05$) were observed within wheat and triticale genotypes (Table 2). In contrary to our findings Khattak *et al*. (2001) who reported non-significant differences in wheat. Spikelets spike^{-1} ranged between 17 and 30 in mixed genotypes with a mean value of 22.97 (Table 3). In triticale experiment, spikelets spike^{-1} ranged between 25 and 30 with a mean value of 27.5, while in wheat experiment, spikelets spike^{-1} ranged between 17 and 20 with a mean value of 18.44 (Table 3). Heritability estimate for spikelets spike^{-1} was 98% (Table 3). Possible explanation of high heritability could be the high genetic variance between wheat and triticale genotypes. However, Mohammad *et al.,* (2001) reported low heritability for this trait. Mixed genotypes showed significantly positive genotypic and phenotypic correlations for spikelets spike^{-1} with plant height and spike length (Table 4). The genotypic and phenotypic correlations of spikelets spike^{-1} with harvest index in wheat genotypes were significantly negative (Table 4). The correlations of spikelets spike^{-1} with harvest index in mixed genotypes of wheat and triticale was non-significant (Table 4).

Spike length: Mixed genotypes and triticale genotypes showed highly significant differences ($p \leq 0.01$) for spike length (Table 2). Khan *et al*., (2001) and Mohammad *et al*., (2004) who also reported highly significant differences for spike length. Orthogonal contrast between wheat and triticale genotypes was highly significant for spike length. The comparative data suggests that triticale genotypes showed more spike length than that of wheat. Differences were non-significant ($p \leq 0.05$) in triticale genotypes (Table 2). The reason for this could be the similar genetic background of the materials for spike length. Data for spike length in mixed genotypes ranged from 9.74 to 13.62 cm with a mean value of 11.74 cm (Table 3). Range of spike length for triticale genotypes was 11.5 to 13.62 cm having a mean value of 12.65 cm while it was 9.74 to 12 cm for wheat with a mean value of 10.93 cm (Table 3). Heritability estimate for this parameter was 84% (Table 3). High heritability indicates that spike length is less influenced by environment. Redid *et al*., (1969) reported low heritability estimate for this trait mixed genotyped showed significantly positive genotypic and phenotypic correlation between spike length with spikelets spike^{-1} and plant height (Table 4). Non-significant correlation were observed in triticale genotypes for spike length with spikelets spike^{-1}, plant height and harvest index (Table 4). Non-significant positive correlation of spike length with plant

height was found which is opposite to the findings of Shahid *et al*., (2002) who reported significant positive correlation between spike length and plant height in wheat (Table 4). Correlation of spike length with other traits was found non-significant (Table 4).

Harvest index: Mixed genotypes showed non-significant differences ($p \leq 0.05$) for harvest index (Table 2). Ihsanullah & Mohammad (2000) and Shah *et al*., (2004) who also reported non-significant differences in wheat which are agree with our findings. The findings of Khan *et al*., (2001) are contradictory to our results. From non-significant difference between wheat and triticale, it can be inferred that they share the same genetic background for this trait and both can be collectively studied. Orthogonal contrast between wheat and triticale genotypes was non-significant for this character. The value of harvest index for mixed genotypes ranged between 5 and 27.8 with a mean value of 20.2 (Table 4). Mixed genotypes showed non-significant phenotypic and genotypic correlations of harvest index with spikelets spike^{-1}, spike length and plant height (Table 4).

Conclusion

The study showed that all the traits except harvest index were positively correlated with each other. The heritability estimates showed that morphological traits were highly heritable and they were less influenced by diverse environmental conditions. While comparing plant height, spikelets spike^{-1}, spike length and harvest index between wheat and triticale, it can be inferred that triticale is a potential substitute for marginal lands.

References

Ahmad, M., F. Mohammad and K. Maqbool. 2003. Genetic variability and traits correlation in wheat. *Sarhad J. Agric*., 19(3): 347-351.

Akbar, H., A. Ali, M. Shafi, B. Ahmad, J. Bakht and H. Saeed. 2000. Comparative study of agronomic traits of old and new wheat varieties. *Sarhad J. Agric*., 16(1): 1-5.

Ihsanullah and F. Mohammad. 2000. Correlation of yield and yield associated traits in spring wheat. *Sarhad J. Agric*. 17(1): 97-100.

Inamullah, H. Ahmad, F. Mohammad, G. Hassan, Siraj-ud-Din and R. Gul. 2006. Diallel analysis of the inheritance pattern of agronomic traits of bread wheat. *Pak. J. Bot*., 38(4): 1169-1177.

Inamullah, H. Ahmad, F. Mohammad, Siraj-ud-Din, G. Hassan and R. Gul. 2006. Evaluation of the heterotic and heterobeltiotic potential of wheat genotypes for improved yield. *Pak. J. Bot*., 38(4): 1159-1168.

Khan, M.A., I. Hussain, M.S. Baloch and O.U. Sayal. 2001. Evaluation of wheat varieties for grain yield in D.I. Khan. *Sarhad J. Agric*., 17(1): 41-46.

Khattak, I.S., G. Hassan, I. Ahmad and M. Hassan. 2001. Evaluation of some elite breeding lines of wheat under the rainfed conditions of Kohat. *Sarhad J. Agric*., 17(4): 564-569.

Malik, M.A. and F. Hassan. 2001. Response of wheat genotypes to nitrogen fertilization under rainfed conditions. *Sarhad J. Agric*., 17(3): 307-310.

Maqbool, K., F. Mohammad and M. Ahmad. 2003. Heritability and traits correlation in triticale. *Sarhad J. Agric*., 19(2): 203-206.

Masood, M.S., A. Javid, M.A. Rabbani and R. Anwar. 2005. Phenotypic diversity and Trait associationin bread wheat (*Triticum aestivum* L.) landraces from Baluchistan, Pakistan. *Pak. J. Bot*., 37(4): 949-957.

Mohammad, F., M.A. Shah, M.S. Swati, T. Shehzad and S. Iqbal. 2004. Genotypic variability for yield and morphological traits in bread wheat. *Sarhad J. Agric*., 20(1): 67-71.

Mohammad. F., H. Daniel, K. Shehzad and H. Khan. 2001. Heritability estimates for yield and its components in wheat. *Sarhad J. Agric*., 17(2): 227-234.

Rafiullah, Z., F. Mohammad, I.H. Khalil and Asadullah. 2007. Heritability for heading, maturity, plant height, spike length and tillers production in winter wheat (*Triticum aestivum* L.). ***Pak. J. Plant. Sci***., 13(1): 67-73.

Redid, M.U., F.G. Heyne and G.H.L. Liang. 1969. Heritability and interrelationship of shortness and other agronomic characters in F_2 and F_4 generation of two wheat crosses. *Crop Sci*., 9: 222-224.

Rehman, M.M. and W.E. Kronstad. 1991. Estimates of Genetic effect in winter wheat crosses. ***Bangladesh J. Agric. Res***., 16(1): 23-27.

Shah, S.M.A., F. Mohammad, M.S. Swati and S. Iqbal. 2003. Genotypic variability for yield association in bread wheat. ***Sarhad J. Agric***., 19(4): 535-538.

Zaheer, A. 1991. Co-heritability among yield and yield components in wheat. ***Sarhad J. Agric***., 7(1): 65-67.

(Received for publication 3 March, 2010)