Research article ***University of Swabi Journal (USJ); Open access***

Evaluation of Elite Wheat Lines under Irrigated Conditions of Peshawar Valley

Saad Ahmad[1]*, Saif Ullah[2], Nawab Ali[2] and Muhammad Mehran Anjum[2]

[1] *Department of Plant Breeding & Genetics, University of Swabi, Swabi – Pakistan*

[2]*Department of Agronomy,The, University of Agriculture Peshawar – Pakistan*

Abstract

An experiment was conducted at ARI (Agricultural Research Institute) Tarnab, Peshawar, during 2013-2014. Twenty eight wheat advanced lines were evaluated for yield and yield contributing traits under irrigated condition using Completely Randomized Block Design. Lines exhibited significant differences for days to heading, days to maturity, plant height, spike length, spikelets per spike, grains per spike and biological yield while non-significant differences for tillers m^{-2}, grain yield and 1000 grain weight. Mean data ranged from 116-123 for days to heading, 157-167 for days to maturity, 73-99cm for plant height, 8.6-11.4 for spike length, 15.67-20.33 for spikelets per spike, 46.33-71.33g for grains per spike, 100.33-239.3 for tillers m^{-2}, 4963-8889 kg ha^{-1} for biological yield, 793.3-1787kg ha^{-1} for grain yield and 38.13-47.7for 1000 grain weight. Correlation analysis revealed significant positive correlation of days to heading with days to maturity and plant height, days to maturity with days to heading, spike length, spike lets per spike, grains per spike, tillers m^{-2}, and biological weight, plant height with days to heading and biological yield, spike length with days to maturity, spikelets per spike, and grains per spike, spikelets per spike with days to maturity, spike length and grains per spike, tiller per m^2 with biological yield and grain yield and biological yield with days to maturity and grain yield, grain yield with tillers m^{-2} and biological yield while tillers m^{-2} had significant negative correlation with days to maturity. Wheat lines MPT-4, 28, 27, and 22 performed well for important traits like days to heading, days to maturity, biological yield, grain yield and 1000 grain weight and thus recommended for further studies.

Keywords: Irrigated, Wheat Lines, Peshawar Valley

**Corresponding author address:* Saad Ahmad

Department of Plant Breeding & Genetics, University of Swabi, Swabi – Pakistan

E-mail: *Saif2012aup@gmail.com*

1. Introduction

Wheat (*Triticumaestivum*) belongs to family Gramineae. The chromosome no of wheat is 42. Wheat is an important cereal crops in the world as well as in Pakistan. It is being cultivated on about 228 million hectare around the world and is being grown on 9.0 million hectares with an annual production of 24.12 million tons in Pakistan. Pakistan ranks 6^{th} in wheat production, 8th in area and 59^{th} in term of yield [1]. Wheat contributes 10.1 percent to the value added in agriculture and 2.2 percent to our national GDP. Area under wheat increased to 8693 thousand hectares in 2012-13, from 8650 thousand hectares showing an increase of 0.5 percent over last year's area. The production stood at 24.2 million tons during 2012-13, against the target of 25.5 million tonnes which is 5.1 percent decrease while an increase of 3.2 percent over the last year production of 23.5 million tonnes has been witnessed. The yield per hectare in 2012-13 stood at 2787 (kg /ha) posted a positive growth of 2.7 percent as compared to negative 4.2 percent growth last year. It is contributing 72% of calories and proteins in Pakistan. (Pakistan survey 2012-2013)

Out of total world crop land area, about 25% is irrigated and rainfed areas of the world are three times greater than irrigated areas. In Pakistan, nearly 80% of agricultural land is irrigated, while the rest 20% is rainfed. But the situation is totally different in KPK where 68.5 % wheat is grown on rainfed areas and 31.5% on irrigated areas. The wheat yield in irrigated areas ranges from 2.5 to 2.8 tons per hectare whereas in rainfed areas it ranges from 0.5 to 1.3 tons per hectare [2].

Wheat grain is a staple food used to make flour for leavened, flat and steamed breads, biscuits, cookies, cakes, breakfast cereal, pasta, noodles, and couscousand for fermentation to make beer,other alcoholic beverages, or biofuel. Wheat is planted to a limited extent as a forage crop for livestock, and its straw can be used as a construction material for roofing thatch. The whole grain can be milled to leave just the endosperm for white flour. The by-products of this are bran and germ. The whole grain is a concentrated source of vitamins, minerals, and protein, while the refined grain is mostly starch.

Wheat grain yields of the country are highly affected by biotic and abiotic or environmental stresses [3, 4]. Major biotic stresses include rust (leaf, yellow and stem rusts) and smut diseases whereas environmental constraints which limit crop productivity include water stress, high temperature and salinity stress [4-7]. The problems of climate change affecting several crops including wheat (increase in temperature and drought) are being addressed at a global level [8-12]. It has been reported that about 20% of irrigated land has been affected by drought and soil salinisation and crop yield has been reduced by 20-30% throughout the world.

Breeders are making continuous efforts to improve wheat yield and production in Pakistan. However, still there is huge gap in yield when compared to some other developing countries. This can be achieved by the agronomic, cultural and the genetic improvement. The improvement to 30-50% in wheat yield has been achieved by the introduction of newly high yielding cultivar in the country [13].

2. Materials and Methods

This experiment was conducted at Agricultural Research Institute (ARI) Tarnab, Peshawar, during 2013-14. The material consisted of 28 advanced wheat lines grown in randomized complete block design (RCBD) having three replications. Each entry was assign a six row plot of 5 m length having a row spacing of 30 cm. Recommended dose of fertilizers and other cultural practices were carried out as and when required.

Table. I. List of various genotypes of Wheat used in present study.

Genotypes	**Genotypes**	**Genotypes**
MPT-1	MPT-11	MPT-21
MPT-2	MPT-12	MPT-22
MPT-3	MPT-13	MPT-23
MPT-4	MPT-14	MPT-24
MPT-5	MPT-15	MPT-25
MPT-6	MPT-16	MPT-26
MPT-7	MPT-17	MPT-27
MPT-8	MPT-18	MPT-28
MPT-9	MPT-19	
MPT-10	MPT-20	

Data were recorded on 50% flowering, date of maturity, plant height, spike length, no of spikelets per spike, no of grains per spike, no of tillers per meter square, thousand grain weight, biological weight and grain yield. Data on days to heading and maturity were recorded from the date of sowing to the date when 50% plants in each plot produced spikes. Days to maturity were recorded from the date of sowing to the date when 50% plants in each plot become physiologically mature.Plant height was measured from the ground level to the tip of the spike excluding awns. Five spikes were collected randomly from each subplot and then their length was calculated with the help of scale manually. Number of spikelets was counted of the randomly selected spikes from each subplot and then their average was taken for further calculations. Five spikes were collected of different sizes randomly from each sub plot, threshed manually and then their grains were counted. Number of tillers per m^2 area counted randomly selected in three rows in each subplot. The data for biological yield were recorded after harvesting the central four rows of each subplot by the help of spring balance. The area of central four rows was six meters square, and then the data was converted into kg/ha. The data for grain yield were recorded after threshing the bundle of each subplot with the help of Tractor voogle thresher. The data were converted into (ha) by dividing area of subplot and multiply by 10 thousand. One thousand grains were taken from yield of each subplot and weighted with the help of electric balance.

3. Results And Discussion

Analysis of variance revealed significant treatment effect on all traits except number of tillers per meter square, grain yield and 1000 grain weight which were declared non-significant (Table 4.1).

3.1. Days to heading

Highly significant (P<0.01) differences were observed among all genotypes for days to heading as shown in Table 4.1. Rafiullah*et al.* 2007 [14] also reported significant variation among wheat genotypes for this trait. The data for days to heading ranged between 116 and 123 days. Minimum days (116 days) to heading were recorded for MPT-4 and maximum (123 days) for MPT-18 as shown in Table 4.2. Days to heading showed significantly positive correlation with days to maturity and plant height (Table 4.4). These findings are in agreement with the findings of Munir *et al.* 2007 [15].

3.2. Days to maturity

Highly significant (P<0.01) differences were observed among all genotypes for days to maturity as shown in (Table 4.1). Rafiullah*et al.* 2007 and Ahmad *et al.*, 2006 [14, 16] also reported significant variation among wheat genotypes in their study. The data for days to maturity ranged between 156 and 167 days. Minimum days to maturity (156 days) were recorded for MPT-24 and maximum (167 days) for MPT-13 as shown in Table 4.2. Days to maturity showed significantly positive correlation with spike length, spikelets per spike, biological yield and grains per spike while significantly negative correlation with tillers m^{-2} (Table 4.4). These findings are in agreement with the findings of Subhani and Chowdhry 2000 [17].

3.3. Plant height (cm)

Highly significant (P<0.01) differences were observed among all genotypes for plant height as shown in Table 4.1. Abbasi*et al.* 2003 and Rafiullah*et al.* 2007 [14, 18] also reported significant variation among wheat genotypes in their study. The data for plant height ranged between 73 and 99cm. Minimum plant height (73cm) was recorded for MPT-28 and maximum (99cm) for MPT-10 as shown in Table 4.2. Plant height showed significantly positive correlation with and days to heading, biological yield as shown in Table 4.4. These findings are in agreement with findings of Abderrahmane*et al.*2013.

3.4. Spike length (cm)

Highly significant (P<0.01) differences were observed among all genotypes for spike length as shown in Table 4.1. Khan *et al.* (2012) [19] also reported significant variation among wheat genotypes in their study. The data for spike length ranged between 8.6 and 11.4 cm. Minimum spike length (8.6 cm) was recorded for MPT-24 and maximum (11.4 cm) for MPT-17 as shown in Table 4.2. Spike length also showed highly significant positive correlation with days to maturity, spikelets per spike and grains per spike Table 2.4. These findings are in agreement with findings of Khan*et al.*2012 [19].

3.5. Spikelets per spike

Highly significantly ($P<0.01$) differences were observed among all genotypes for number of spike lets per spike as shown in Table 4.1. The minimum numbers of spikelets 15 was recorded and maximum 20 in MPT- 24 and 18 respectively (Table 4.2.). Spikelets also showed highly significant positive correlation with grains per spike, days to maturity, and spike length (Table 4.4). These findings are in agreement with findings of Ashraf *et al*.2001.

3.6. Grains per spike

Highly significant ($P<0.01$) differences were observed among all genotypes for grains spike-1 as shown in (Table 4.1). Ahmad *et al.* (2006) [1] also reported significant variation among wheat genotypes in their study. The data for grains spike^{-1} ranged between 46 and 71 grains spike^{-1}. Minimum grains spike^{-1} (46 grains spike-1) was recorded for MPT-10 and maximum (71 grains spike-1) for MPT-13 as shown in Table 4.3. Grains per spike showed also significant positive correlation with days to maturity and spike length as shown in Table 4.4. These findings are in agreement with findings of Mohsen *et al.* 2012 [20].

3.7. Tillers m^{-2}

Non-significant ($P<0.05$) differences were observed among all genotypes for number of tillers m^{-2} (Table 4.1). The data for tillers m^{-2} ranged between 100 and 239 tillers m^{-2}. Minimum tillers m^{-2} (100) was recorded for MPT-13 and maximum (239) for MPT-3 as shown in Table 4.3. Tillers m^{-2} showed highly significant positive correlation with biological yield and grain yield as shown in Table 4.4. These findings are in agreement with findings of Guendouz*et al*. 2013 [21].

Table.4.1. Mean squares for various traits of Wheat genotypes evaluated at ARI, Tarnab, Peshawar and KPK during 2013-2014.

TRAITS	Replication	Genotypes	Error	CV
Day To Heading	8.03	7.19**	0.94	0.81
Days To Maturity	21.77	21.54**	2.85	1.05
Plant Height	33.63	113.49**	23.32	5.53
Spike Length	5.32	1.40**	0.38	5.88
Spikelets per Spike	9.97	4.70**	1.14	5.82
Grains per Spike	369.7	87.36**	39.16	11.46
Tiller m^{-2}	6499.8	2361.2^{ns}	1334.2	19.79
Biological Yield	1982519	2108549*	1303153	15.79
Grain Yield	434062	172688^{ns}	100991	21.53
1000 Grain Weight	4.45	24.62^{ns}	14.49	8.84

3.8. Biological yield (kg ha^{-1})

Significant ($P<0.01$) differences were observed among all genotypes for biological yield (Table 4.1). Abbasi*et al.* 2003 also reported significant variation among wheat genotypes in their study. The data for biological yield ranged between 4963 and 8889 kg ha^{-1}. Minimum biological yield (4963 kg ha-1) was recorded for MPT-13 and maximum (8889 kg ha-1) for MPT-22 as shown in Table 4.3. Biological yield also showed significantly positive correlation with grain yield, plant height and tillers m^{-2} as shown in Table 4.4. These findings are in agreement with findings of Nasir*et al.* 1999.

3.9. Grain yield (kg ha^{-1})

Non-significant ($P<0.05$) differences were observed among all genotypes for grain yield (Table 4.1). The data for grain yield ranged between 793.3 and 1787 kg ha^{-1}. Minimum grain yield (793.3 kg ha-1) was recorded for MPT-1 and maximum (1787 kg ha^{-1}) for MPT-4 as shown in Table 4.3. Grain yield also showed significant correlation with tillers m^{-2} and biological yield as shown in Table 4.4. These findings are in agreement with findings of Abderrahmane*et al*. 2013.

3.10. 1000 Grain weight (g)

Non-significant ($P<0.05$) were observed among all genotypes for 1000 grain weight (Table 4.1). The data for 1000 grain weight ranged between 38.13 and 47.7 g. Minimum 1000 grain (38.13 g) weight was recorded for MPT-10 and maximum (47.7 g) for MPT-16 as shown in Table 4.3. 1000 grain weight also showed non-significant correlation with all traits as shown in Table 4.4.

Table.4.2. Mean values for Days to heading (DH), Days to maturity (DM), Plant height (PH), Spike length (SL), Spikelets per spike (SL/S) of twenty eight genotypes evaluated at ARI, Tarnab, Peshawar during 2013-2014.

Means in a column following different letters are significantly different at 5% level of probability.

Genotypes	**DH**	**DM**	**PH**	**SL**	**SL/S**
Genotypes	**G/S**	**T/m^2**	**BY ($kg\ ha^{-1}$)**	**GY ($kg\ ha^{-2}$)**	**GW (g)**
MPT-1	119 f-j	161 d-h	85 f-j	10 e-g	20 ab
MPT-2	118 kl	159 g-i	82 h-k	10 e-g	17 d-f
MPT-3	122 ab	163 c-e	85 f-j	10 d-g	17 c-f
MPT-4	116 m	157 i	90 b-g	9 gh	16 ef
MPT-5	119 f-j	160 f-h	88 d-i	11 a-c	17 c-f
MPT-6	118 i-l	161 d-h	92 a-f	10 e-g	17 d-f
MPT-7	119 f-j	161 d-h	90 c-h	11 a-e	20 ab
MPT-8	120 c-g	162 d-g	84 g-i	10 a-f	19 ab
MPT-9	121 b-f	161 d-h	94 a-e	11 a-d	20 ab
MPT-10	119 g-k	161 e-h	99 a	10 a-f	17 c-f
MPT-11	117 lm	162 d-f	86 d-i	10 a-e	19 ab
MPT-12	119 h-l	162 d-f	85 f-i	10 b-g	20 ab
MPT-13	120 d-h	167 a	75 kl	11 ab	20 ab
MPT-14	120 d-h	166 ab	77 jl	11 a-c	19 a-c
MPT-15	119 g-k	162 d-g	81 i-k	10 a-e	19 a-c
MPT-16	120 d-h	162 ab	87 d-i	11 a-e	18 b-e
MPT-17	120 e-i	164 b-d	88 d-i	11 a	20 a
MPT-18	123 a	162 d-f	91 b-g	11 a-c	20 a
MPT-19	119 g-k	161 e-h	86 f-i	11 a-e	19 a-c
MPT-20	122 ab	165 a-c	86 e-i	10 e-g	17 c-f
MPT-21	122 a-c	162 d-f	89 c-i	10 e-g	18 b-e
MPT-22	120 d-h	159 g-i	97 a-c	10 e-g	18 b-e
MPT-23	121 b-d	160 e-h	98 ab	11 a-c	18 b-e
MPT-24	118 i-l	157 i	85 f-j	9 h	16 f
MPT-25	119 f-j	162 d-f	87 d-i	11 a-e	17 c-f
MPT-26	121 b-f	161 e-h	89 c-h	9 f-h	18 b-e
MPT-27	119 g-k	161 hi	94 a.d	11 a-e	19 a-c
MPT-28	118 j-l	161 i	73 l	10 c-g	18 b-d

Table.4.3. Mean values Grains per spike (G/S), Tillers per m2 (T/m2), Biological yield (BY) and Grain weight (GW) of twenty eight Wheat genotypes evaluated at ARI, Tarnab, Peshawar during 2013-2014.

MPT-1	57 b-g	173 b-e	6667 b-f	793 e	45 a-f
MPT-2	49 e-h	212 a-c	6852 b-e	1563 a-c	43 a-g
MPT-3	49 e-h	239 a	7963 a-d	1563 a-c	42 a-g
MPT-4	48 gh	220 ab	7926 a-d	1787 a	47 ab
MPT-5	52 c-h	199 a-d	7037 a-e	1687 ab	44 a-g
MPT-6	53 b-h	186 a-e	6778 b-f	1478 a-d	42 a-g
MPT-7	63 ab	187 a-e	7111 a-e	1541 ac	46 a-d
MPT-8	59 b-f	207 a-d	8148 a-c	1457 a-d	40 d-g
MPT-9	60 b-d	198 a-d	8074 a-c	1403 a-d	40 d-g
MPT-10	46 h	193 a-d	8518 ab	1598 a-c	38 g
MPT-11	51 c-h	189 a-e	7451 a-e	1294 a-e	41 b-g
MPT-12	55 b-h	170 b-e	7593 a-e	1667 ab	46 a-d
MPT-13	71 a	100 f	4963 f	1094 c-e	44 a-g
MPT-14	61 a-c	167 b-e	6482 c-f	961 de	39 e-g
MPT-15	59 b-e	186 a-e	7593 a-e	1602 a-c	41 b-g
MPT-16	55 b-h	133 ef	5741 ef	1354 a-d	48 a
MPT-17	61 a-c	181 a-e	6852 b-e	1326 a-d	38 g
MPT-18	55 b-h	152 d-f	7778 a-d	1367 a-d	39 fg
MPT-19	55 b-h	165 b-e	6852 b-e	1485 a-c	44 a-g
MPT-20	53 b-h	180 a-e	7445 a-e	1636 ab	43 a-g
MPT-21	51 d-h	155 c-f	7222 a-e	1199 b-e	46 a-d
MPT-22	49 f-h	204 a-d	8889 a	1685 ab	43 a-g
MPT-23	57 b-g	171 b-e	7963 a-d	1655 ab	47 a-c
MPT-24	52 c-h	211 a-d	7593 a-e	1735 a	43 a-g
MPT-25	52 c-h	183 a-e	6556 c-f	1444 a-d	45 a-e
MPT-26	52 c-h	201 a-d	7222 a-e	1578 a-c	41 c-g
MPT-27	51 d-h	191 a-e	7037 a-e	1767 a	44 a-g
MPT-28	52 c-h	215 a-c	6111 d-f	1618 ab	47 ab

Means in a column following different letters are significantly different at 5% level of probability.

Table.4.4. Correlation of different Wheat Traits evaluated at ARI, Tarnab, Peshawar during 2014.

	DH	**DM**	**PH**	**SL**	**SL/S**	**G/S**	**Tm^{-2}**	**BY**	**GY**
DM	0.4654*								

PH	0.3474*	-0.0187							
SL	0.3021	0.4830*	0.1729						
SL/S	0.2418	0.3557*	0.0565	0.7502**					
G/S	0.2536	0.4981*	-0.1001	0.6728**	0.6980*				
Tm^{-2}	-0.1920	0.3932	0.1530	-0.2523	-0.2401	-0.2935			
BY	0.2125	0.0496	0.5313*	0.0717	0.0633	-0.0706	0.4960*		
GY	-0.0568	-0.1030	0.2125	-0.0358	-0.1027	-0.0817	0.3349*	0.5141*	
GWt	-0.0967	-0.0936	-0.1147	-0.0653	-0.2212	-0.0107	-0.0225	-0.2125	0.0057

*. Correlation is significant at the 0.05 level.
**. Correlation is significant at the 0.01 level.

DH= Days to heading, DM= Days to maturity, PH= Plant height, SL= Spike length, SL/S= Spikelets per spike, G/S= Grains per spike, Tm^{-2}= Tillers per meter square, BY= Biological Yield, GY= Grain yield, GWt= Grain weight.

CONCLUSION AND RECOMMENDATIONS

It is concluded from the present research that wheat lines 4, 28, 27, and 22 performed well for important traits like days to heading, days to maturity, biological yield, grain yield and 1000 grain weight. However, further research on multi-location and year trials is necessary to exploit full potential of these genotypes and future recommendations to farmers.

4. References

1. Ashfaq, M., F. Zulfiqar, I. Sarwar, M.A. Quddus and I.A. Baig. 2011. Impact of climate change on wheat productivity in mixed cropping system of Punjab. Soil Environ., 30(2): 110-114.
2. Akhtar. L.H, M. Hussain, A. H. Tariq and M. Nasim. 2010. A review of hundred years of wheat research and development in Punjab (1911-2010). Pak J. Sci 62(2): 128-134.

3. Khavarinejad, M.S. and M. Karimov. 2012. Study of Genetic diversity among spring wheat genotypes in drought stress by advanced statistical analysis. Int. j. Agri and PltProduc. 3(12): 590-598.
4. Kimurto, P.K., M.G. Kinyua and M.J. Nijoroge. 2003. Response of bread wheat genotypes to drought stimulation under a mobile rain shelter in Kenya. African Crop Science Journal, 11 (3): 225-234.
5. Johari, P., Moharram and M. Habib. 2011. Evaluation of 10 wheat cultivars under water stress at Moghan (Iran) conditions. African. J. Biot. 10 (53): 10900-10905.
6. Edward, D., and D. Wright. 2008. The effects of winter water-logging and summer drought on the growth and yield of winter wheat (Triticumaestivum L.). European J. Agron., 28: 234–244.
7. Savin, R. and M.E. Nicolas. 1999. Effect of timing of heat stress and drought on growth and quality of barley grains. Aust. J. Agric. Res. 50; 357-364.
8. Plaut, Z., B.J. Butow, C.S. Blumenthal and C.W. Wrigley. 2004. Transport of dry matter into developing wheat kernels. Field Crops Res. 96:185-198.
9. Passioura, J.B. 2007. The drought environment: physical, biological and agricultural perspectives. Journal of Experimental Botany. 58: 113–117.
10. Reynolds, M.P., S. Nagarajan, M.A. Razzaque and O.A.A. Ageeb. 2001. Heat tolerance. In: Application of Physiology in Wheat Breeding (Eds.): Reynolds, M.P., J.I. Ortiz- Monasterio and A. Mc. Nab. Mexico, D.F.: CIMMYT, pp. 124-135.
11. Najafian, G. 2003. Screening of high volume breeding lines of hexaploid wheat for drought tolerance using cluster analysis based on kernel yield and STI. Proceedings of 10th International Wheat Genetics Symposium, 1-6 Sept. Paestum, Italy.
12. Rajki, E. 1982. Drought sensitive phase in development of wheat and possibility of testing drought resistance in the phytoron. Cereal Res. Comm., 10: 213-221.
13. Mirza, H., Wasiullah, J. Iqbal and M. Illyas. 2003. Evaluation of wheat varieties under the agro climatic conditions of Barani Agriculture research station Kohat. Pakistan Journal of Agronomy 2(1):8-12.
14. Rafiullah, Z. Mohammad, I.H. Khalil and Asadullah. 2007. Heritability for heading, maturity, plant height, spike length and tillers production in winter wheat (Triticumaestivum L.). Pak. J. Pl. Sci. 13(1): 67-73.
15. Munir, M., M.A. Chowdhry and T.A. Malik. 2007. Correlation studies among yield and its components in bread wheat under drought conditions. In African Crop Science Journal t'l. J. Agric. Biol. 9(2): 287-290.

16. Ahmad, M., Z. Akram, M. Munir and M. Rauf. 2006. Physiomorphic response of wheat genotypes under rainfed conditions. Pak. J. Bot. 38(5): 1697-1702.
17. Subhani, G.M. and M.A. Chowdhry. 2000. Correlation and path coefficient analysis in bread wheat under drought stress and normal conditions. Pak. J. Biol. Sci. 3: 7-72.
18. Abbasi, M.K., R.H. Kazmi and M.Q. Khan. 2003. Growth performance and stability analysis of some wheat genotypes subjected to water stress at Rawalakot Azad Jammu and Kashmir. Archives Agron. Soil. 49: 415-426.
19. Khan, F.U., Inamullah, I.H. Khalil, S. Khan, and I. Munir, 2012. Yield stability, genotypic and phenotypic correlation among yield contributing traits in spring wheat under two environments. . Sarhad J. Agri. 28(1): 27(36).
20. Mohsen, A.A.E., S.R.A. Hegazy and M.H. Taha. 2012. Genotypic and phenotypic interrelationships among yield and yield components in Egyptian bread wheat genotypes. Journal of Plant Breeding and Crop Science, 4(1): 9-16.
21. Guendouz, A., M. Djoudi, S. Guessoum, K. Maamri, Z. Fellahi, A. Hannachi and M. Hafsi. 2013. Durum wheat (Triticum durum Desf.) Evaluation Under semi-Arid Conditions In Eastern Algeria by Path Analysis. J. Agriculture and Sustain, 3(1): 56-64.