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RESEARCH ARTICLE

Assessment of Morphological and Yield-related Traits in *Triticum aestivum* L

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ABSTRACT

Wheat is a staple grain food throughout the globe. Drought is an important abiotic stress which significantly reduces crop production. Crop plants response to drought stress through certain morphological and physiological traits. Wheat plant traits in response of drought stress are crucial to ensure high yield in drought conditions. Current study was conducted to check the various variations in wheat *(Triticum aestivum L)* genotypes at drought condition. Therefore, it is necessary to develop such varieties which are easily surviving in water scarcity areas. This research was held in the experimental field area of department of Plant Breeding and Genetics, Faculty of Agriculture and Environment, The Islamia University of Bahawalpur, LSD design with three replications was applied to study the different genotypes of wheat under drought stress. Thirty genotypes were used for study. Two sets of plots are design one in normal condition and other plot undergoes to drought stress. Results on morphological based shows that genotype 213 has shown good results at drought stress with minimum (18.267) reduction rate in Plant height, genotype 228 has shown better performance with minimum (1.6) reduction rate in Numbers of Tillers, genotype 215 has represents better conclusions with minimum (7.4) reduction rate in Spike Length, In Peduncle length genotype 217 shows minimum (6.8) reduction rate in drought stress. Genotype 202 has shown better performance with minimum (8) reduction rate. In Thousand Grain weight genotype 201 has shown better performance with minimum (32.567) reduction rate and in Grain Yield per Plant genotype 216 has shown minimum (3.367) reduction rate in drought stress. Therefore, in future by manipulate advanced breeding techniques, these genotypes have played an important character to provide path to liberal the drought resistance specie to encounter the problem of water lacking for agriculture region in Pakistan.

Key words: Wheat genotypes, Drought stress, Morphological traits, Water-scarcity adaptation, Breeding techniques

INTRODUCTION

Wheat (*Triticum aestivum*. L) is a staple food crop which belongs to family Poaceae and sub- family is Pooideae and the genus Triticum (Afzal *et al*., 2023). Genus Triticum is further divided into three different ploidy levels. Group one is diploid having 2n=2x=14, group two is Tetraploid with 2n=4x=28 and the group three is hexaploid with 2n=6x=42 chromosomes numbers with ABD Genome. Wheat comprises of six species which are Triticum urartu, Triticum monococcum, Triticum turgidum L, Triticum timopheevi, Triticum zhukovskyi and Triticum aestivum (Dubcovsky and Dvorak, 2007). Triticum aestivum L. (AABBDD) is first domesticated in western area during early Holocene by the hybridization of tetraploid emmer wheat (AABB) with wild specie Aegilops tauschii (DD) (Mehboob *et al*., 2020b).

Wheat is mostly cultivated in temperate region but also sowed on tropical and sub-tropical areas which are extremely hot and dry regions. The hot and dry region leads towards abiotic stress. Drought is the environmental condition which reduces plant growth and yield below optimum level (AFZAL *et al*., 2023). Plant responses to abiotic stress are dynamic and complex. Among abiotic stress, drought is most common which affects the wheat growth and development (Mehboob *et al*., 2020a). Drought stress is responsible to stop the crop production. Drought stress is event of shortage in water supply (Khalid, 2022). Drought stress reduces the water availability in plants (Babar *et al*., 2023). Drought stress is the main reason for the lower water potential.

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Drought stress stimulated damage in plants (*Aghdam et al., 2016*). Drought stress is the most important environmental factor in many parts of the world; especially in dry area which limit the crop yield.

Drought stress is considered as the one of the more hazardous stresses which affects the crop productivity more than any other environmental factors (Lambers *et al*., 2008). Drought stress leads to decrease in leaf size and number. Drought stress inhibits mitosis and cell elongation.

which results in poor growth in plants. Drought stress causes severe effects on crop growth and development. Drought stress reduces the seed germination due to less water uptake. Drought stress reduces dry matter accumulation and grain yield. Drought stress occurs at vegetative period of crop growth which reduces economic yield. Drought stress affects crop phenology which shortening the crop growth cycle (Babar *et al*., 2022).

Some morphological characters such as tillering, no. of spikes, no. of fertile tillers per plant, 1000 grain weight, and peduncle length affect wheat tolerance in soil (Ammar et al., 2022; Babar et al., 2023; Chaudhry et al., 2022). Drought stress is the major cause of abiotic factor for yield reduction (Imtiaz et al., 2022; IQBAL et al., 2023; SHAFIQUE et al., 2023). Drought stress affects crop plants which disturb the grain production from seedling to ripening (Khalid, *et al*., 2021). Drought stress is the cause of moderate loss of water leads to stomata closure and limitation of gas exchange. Drought stress reduces seed germination in plants (Sun and and Tanumihardjo 2007). Drought stress affects the crop phenology by shorten the crop growth cycle. Drought stress reduces leaf area. Drought stress at grain development decreases grain yield (Shahani *et al*., 2021).

Drought stress is one of the main constrain for plants breeder in wheat crop. Drought stress effects plant growth and physiological process of growth (Khalid, *et al*., 2021). Drought stress has five types which are meteorological, hydrological, pedological, agronomic and sociological drought. Drought stress occurs due to poor management and planning at local or regional stage (Razzaq et al., 2021; Zafar et al., 2020).

Winter wheat is effortlessly disturbed by drought and showing inferior output and more than 70% of winter wheat is soaked to secure balanced supply. In case of climate changes drought and heat stress duration are assumed to be more expand both in occurrence and in power (Razzaq et al., 2020; Zafar et al., 2022).

Plant breeders try to improve wheat varieties under drought condition by using new molecular techniques to enhance the yield of wheat crop (Khalid and Amjad, 2018). Wheat breeder use multilayer technology to breed drought stress genotypes to develop better understanding of physiological and genetic basis of wheat crop (Mwadzingeni *et al*., 2016).

MATERIALS AND METHODS

The experiment was carried out to discover the drought resistance capability of best yielding wheat genotypes on the basis of morphological components. Experiment was performed in rabi season at the experimental field area of department of plant breeding and genetics, faculty of agriculture and environment, Islamia University of Bahawalpur. Meter rod was used to measure the record of different features. Genotypes utilized in this layout were taken from Regional Agriculture Research Institute and Ayub Agriculture Research Institute (Table 1) which having 30 x 2 water treatment 1st was normal treatment and 2nd was suffer to drought stress fixed as an LSD with three replications. Thirty wheat genotypes were applicable in an experimental field area of department of plant breeding and genetics. Normal wheat genotypes were watered three times and water prohibits until 15 days during drought period. The plants were 4 times watered at normal condition and at drought stress watered 3 time and skip the water at dough stage. The plants at drought stress condition were maintained at soil water capacity (abu Haraira et al., 2022; Amjad et al., 2022). Morphological information was recorded at different stages.

RESULTS AND DISCUSSION

Plant Height (cm)

Performance of different genotypes of wheat crop as 30 genotypes showed maximum reduction for plant height under drought stress (Table 2). Relationship between different traits was studied by correlation method (Hamza et al., 2018; Kamal et al., 2019; Mustafa et al., 2022). Comparison test for Genotype x Environment showed that reduction rate genotype 222 was highly affected for plant height under drought as the reduction rate was 26.267 mean while genotype 213 shows resistance against drought with minimum reduction rate of 18.267. Plant height decreased under drought condition due to difference in genetic traits of different cultivars (Table 3).

Number of Tillers/ Plants

Tillers shows Positive or Negative effect on wheat output which is based on natural resources. Analysis of variance of tillers is given in Table 4. Comparison test for G x E is given Table 5. Genotype 228 (1.6) has shown minimum reduction under drought stress. Number of tillers shows minimum reduction at drought condition.

Spike Length (cm)

Spike is not only organ which contain grain but also play a pivotal role in photosynthetic activity. Analysis for spike length is given Table 6. Comparison test of G X E is given in Table 7. Genotype 215 has shown minimum (7.4) reduction rate at drought condition. Spike length decreases when plants undergo to drought stress (Razzaq et al., 2020; Zafar et al., 2020).

Table 1: Genotypes which were studied in experiment

1.Sehar	9.Lasani-08	17.Ass-11	25.Pak-13
2. SA-75	10-Millet-11	18.Akbar	26.Punjab-11
3.Bhawalpur-79	11.Inqalab-91	19.Ghazi-19	27.Sariab-92
4Bwp-97	12.Barani	20.Johar-16	28.Pirsabak-91
5.Fsd-83	13.Sarhad-82	21.Anaaj	29.Bahawalpur-2000
6.Sarhad-82	14.Galaxy	22.T.D-1	30. Aur-10
7. Pak-81	15.Abdul Sattar	23.FSD-8	
8.AARI-11	16.Fareed	24-Punjab-85	

Table 2: ANOVA of Variance for Plant height (cm)

Source	DF	SS	MS	F	P
Rep	2	5	3		
Var	29	1395	48	3.24**	0.0000
Tr	1	131931	131931	8873.02**	0.0000
Var*tr	29	966	33	2.24*	0.0000
Error	118	1755	15		
Total	179	136051			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance: *significance

Table 3: LSD All-Pair wise Comparisons Test of PH for var*tr

Varieties	Treatment	Mean	Homogeneous Groups
205	1	91.933	A
209	1	81.867	B
229	1	81.667	B
215	1	81.383	BC
211	1	81.2	BCD
228	1	80.5	BCD
210	1	80.333	BCD
220	1	79.753	BCDE
208	1	78.633	BCDEF
202	1	77.95	BCDEFG
219	1	77.89	BCDEFG
204	1	77.45	BCDEFG
201	1	77.35	BCDEFG
203	1	77.35	BCDEFG
207	1	76.433	BCDEFGH
212	1	76.267	BCDEFGH
222	1	75.963	BCDEFGH
206	1	75.267	CDEFGHI
217	1	75.013	DEFGHI
216	1	73.827	EFGHIJ
223	1	73.8	EFGHIJ
213	1	73.133	FGHIJ
227	1	73.007	FGHIJ
225	1	73	FGHIJ
221	1	72.507	FGHIJ
230	1	72.333	GHIJ
224	1	72	GHIJ
226	1	70.333	HIJ
214	1	69.6	IJ
218	1	68.237	J
222	2	26.267	K
205	2	26	KL
227	2	25.067	KLM
223	2	25	KLM
204	2	24.933	KLM
218	2	24.533	KLMN
203	2	24.467	KLMNO
202	2	23.933	KLMNO
206	2	23.733	KLMNO
210	2	23.6	KLMNO
220	2	23.333	KLMNO
201	2	23.2	KLMNO
219	2	22.6	KLMNO
224	2	22.6	KLMNO
207	2	22.467	KLMNO
211	2	22.2	KLMNO
216	2	22.2	KLMNO
217	2	22.2	KLMNO
209	2	22.133	KLMNO
226	2	21.6	KLMNO
225	2	21.267	KLMNO
215	2	21.2	KLMNO
228	2	20.467	KLMNO
208	2	20.467	KLMNO
229	2	20	LMNO
212	2	19.8	LMNO
221	2	19.733	MNO
230	2	19.667	MNO
214	2	18.667	NO
213	**2**	**18.267**	**O**

Table 4: Analysis of Variance Table for Number of tillers

Source	DF	SS	MS	F	P
Rep	2	5.41	2.71	5.00**	0.0000
Var	29	375.62	12.55	1356.83**	0.0000
Tr	1	3516.55	3516.55	4.91*	0.0000
Var*tr	29	369.37	12.74		
Error	118	305.83	2.59		
Total	179	4572.78			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance: *significance

Peduncle Length (cm)

Peduncle length can be measured from the end of spike to the 1st node of plant. Analysis of variance for peduncle length is shown in Table 8. Comparison test for G x E of peduncle length is shown in Table 9. Reduction rate in genotype 212 is maximum (10.467) and minimum reduction rate in genotype 217 (6. 800) during drought condition.

Number of Spike Lets Per Spikes

Number of spikelets per spikes connected with number of kernels per spike. These components are highly related with wheat crop. Analysis of variance for spikelets per spikes is given in Table 10. Comparison test for G x E can be shown in Table 11. Genotype 202 (8) shows minimum reduction at drought condition. Decreases in spikelets per spike at drought terms may be referred to Primordial Spikelets produced during tillering, or could credited with floating death at terminal and basal ends of spike during stem extension (SHAH et al., 2023; Shahani et al., 2021).

Thousand Grain Weight (TGW) (gram)

Analysis of thousand grain weight is given in Table 12 which shows that there is a significant difference between genotypes. Comparison test for G x E is show in Table 13. Maximum thousand grain weight is shown in genotype 207 (38.017). Minimum grain weight is shown in genotype 224 (1.377) at drought stress. It was also observed that grains were shriveled by drought stress and their degree depends on variety and prevailed drought stress. Shriveling also effect grain weight and

Table 5: LSD All-Pair wise Comparisons Test of NT for var*tr

Varieties	Treatment	Mean	Homogeneous Groups
222	1	17.4	A
220	1	16.867	A
219	1	14.8	AB
216	1	14.067	BC
205	1	13.067	BCD
218	1	12.733	BCDE
212	1	12.533	BCDEF
210	1	12.4	BCDEF
221	1	12	CDEFG
204	1	11	DEFGH
223	1	11	DEFGH
229	1	10.867	DEFGH
213	1	10.667	DEFGH
206	1	10.4	EFGH
208	1	10.4	EFGH
214	1	10.4	EFGH
207	1	10.267	EFGH
226	1	10.2	EFGH
228	1	10.133	EFGHI
211	1	10	FGHI
227	1	9.933	FGHI
230	1	9.667	GHI
203	1	9.4	GHI
215	1	9.267	HI
225	1	9.133	HI
202	1	8.9	HI
201	1	8.7	HI
224	1	7.533	I
217	1	4.267	J
209	1	3.667	JK
225	2	2.467	JK
212	2	2.333	JK
211	2	2.333	JK
229	2	2.2	JK
221	2	2.133	JK
201	2	2.067	JK
202	2	2.067	JK
210	2	2.067	JK
218	2	2	JK
209	2	1.933	JK
203	2	1.933	JK
206	2	1.933	JK
207	2	1.933	JK
204	2	1.933	JK
220	2	1.867	JK
208	2	1.867	JK
213	2	1.867	JK
219	2	1.867	JK
222	2	1.8	JK
223	2	1.8	JK
205	2	1.733	JK
214	2	1.733	JK
226	2	1.667	JK
227	2	1.667	JK
224	2	1.6	K
228	2	1.6	K

Table 6: Analysis of Variance Table for Spike length

Source	DF	SS	MS	F	P
Rep	2	27.37	13.685		
Var	29	1224.42	42.221	3.19**	0
Tr	1	107.99	107.989	8.15**	0.0051
Var*tr	29	1435.45	49.498	3.74*	0
Error	118	1563.77	13.252		
Total	179	4359			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance: *significance.

Table 7: LSD All-Pair wise Comparisons Test of SL for var*t

Varieties	Treatment	Mean	Homogeneous Groups
218	1	26.717	A
209	1	17.867	B
217	1	15.253	BC
219	1	14.983	BCD
216	1	13.967	BCDE
201	1	13.35	BCDEF
207	1	13.333	BCDEF
222	1	13.32	BCDEF
211	1	12.847	BCDEFG
202	1	12.45	BCDEFG
213	1	12.373	BCDEFG
212	1	12.3	BCDEFG
210	1	12.1	BCDEFG
208	1	12.067	BCDEFG
214	1	11.9	CDEFG
206	1	11.867	CDEFG
220	1	11.813	CDEFG
221	1	11.677	CDEFG
204	1	11.55	CDEFG
203	1	11.45	CDEFG
206	2	11	CDEFG
226	2	10.867	CDEFG
220	2	10.533	CDEFG
214	2	10.4	CDEFG
229	2	10.4	CDEFG
215	1	10.29	CDEFG
219	2	10.267	CDEFG
223	2	10.267	CDEFG
205	1	10.1	CDEFG
203	2	9.8	CDEFG
216	2	9.667	CDEFG
204	2	9.467	CDEFG
207	2	9.267	DEFG
217	2	9.267	DEFG
227	2	9.267	DEFG
230	2	9.133	DEFGH
208	2	9	EFGH
211	2	8.867	EFGHI
222	2	8.867	EFGHI
213	2	8.667	EFGHI
224	2	8.6	EFGHI
225	2	8.533	EFGHI
201	2	8.467	EFGHI
205	2	8.4	EFGHI
218	2	8.33	EFGHI
228	2	8.67	EFGHI
202	2	7.967	FGHI
209	2	7.933	FGHI
212	2	7.933	FGHI
210	2	7.867	FGHI
221	2	7.667	FGHI
215	2	7.4	GHI
227	1	3.33	HI
229	1	3.33	HI
230	1	3.33	HI
228	1	3.267	HI
223	1	3	I
224	1	3	I
225	1	3	I
226	1	3	I

Table 8: Analysis of Variance Table for Peduncle length

Source	DF	SS	MS	F	P
Rep	2	24	12		
Var	29	912.8	31.5	7.46**	0
Tr	1	23925.2	23925.2	5668.73**	0
Var*tr	29	986.8	34	8.06*	0
Error	118	498	4.2		
Total	179	26346.9			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance: *significance.

Table 9: LSD All-Pair wise Comparisons Test of PL for var*tr

Varieties	Treatment	Mean	Homogeneous Groups
215	1	44.767	A
205	1	42.467	A
229	1	37.683	B
210	1	36.067	BC
228	1	35.717	BC
220	1	35.1	BCD
219	1	34.71	BCD
211	1	34.567	BCD
217	1	33.913	CDE
209	1	33.733	CDE
216	1	33.27	CDEF
212	1	32.767	CDEF
218	1	32.763	CDEF
204	1	31.8	DEFG
201	1	30.95	EFGH
207	1	30.733	EFGH
203	1	30.7	EFGH
223	1	30.667	EFGH
224	1	30.667	EFGH
221	1	30.643	EFGH
213	1	30.033	FGHI
202	1	29.95	FGHI
230	1	29	GHI
208	1	28.967	GHI
227	1	28.78	GHI
222	1	28.36	HI
225	1	27.233	I
206	1	27.133	I
226	1	27	I
214	1	21.967	J
212	2	10.467	K
203	2	10.333	K
204	2	10.333	K
201	2	10.3	KL
219	2	10	KLM
216	2	9.867	KLM
207	2	9.8	KLM
220	2	9.8	KLM
221	2	9.667	KLM
226	2	9.667	KLM
227	2	9.667	KLM
210	2	9.6	KLM
223	2	9.4	KLM
230	2	9.333	KLM
205	2	9.333	KLM
229	2	9.2	KLM
202	2	9.067	KLM
206	2	9.067	KLM
228	2	9.067	KLM
218	2	9	KLM
225	2	8.733	KLM
208	2	8.733	KLM
224	2	8.333	KLM
222	2	7.933	KLM
214	2	7.933	KLM
209	2	7.867	KLM
211	2	7.267	KLM
215	2	7	LM
213	2	6.8	M
217	2	6.8	M

Table 10: Analysis of Variance Table for Number of spikelets per spikes

Source	DF	SS	MS	F	P
Rep	2	284.02	142.011		
Var	29	1079.31	37.218	2.17**	0.0019
Tr	1	497.47	497.47	29.07	0
Var*tr	29	906.15	31.247	1.83*	0.0131
Error	118	2019.4	17.114		
Total	179	4786.35			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance; *significance.

Table 11: LSD All-Pair wise Comparisons Test of SPS for var*tr

Varieties	Treatment	Mean	Homogeneous Groups
209	1	22.6	A
217	1	20.867	AB
222	1	20.867	AB
215	1	20.433	AB
222	2	20.333	AB
207	1	19.667	ABC
208	1	19.333	ABCD
210	1	19.267	ABCD
203	1	19.2	ABCD
214	1	19	ABCDE
221	2	19	ABCDE
205	1	18.933	ABCDE
206	1	18.8	ABCDEF
212	1	18.667	ABCDEF
211	1	18.4	ABCDEFG
213	1	18.2	ABCDEFGH
201	1	18.1	ABCDEFGHI
221	1	18.067	ABCDEFGHI
220	1	18	ABCDEFGHIJ
202	1	17.5	ABCDEFGHIJK
219	1	17.4	ABCDEFGHIJK
220	2	17.333	ABCDEFGHIJKL
204	1	17.3	ABCDEFGHIJKL
218	1	17	ABCDEFGHIJKL
219	2	16.667	ABCDEFGHIJKLM
224	2	16	ABCDEFGHIJKLMN
205	2	15.333	BCDEFGHIJKLMNO
213	2	15.333	BCDEFGHIJKLMNO
217	2	15.333	BCDEFGHIJKLMNO
223	2	15.333	BCDEFGHIJKLMNO
225	2	15.333	BCDEFGHIJKLMNO
218	2	15	BCDEFGHIJKLMNO
216	1	14.933	BCDEFGHIJKLMNO
215	2	13.333	CDEFGHIJKLMNOP
216	2	13	CDEFGHIJKLMNOP
229	2	12.833	DEFGHIJKLMNOP
201	2	12.667	DEFGHIJKLMNOP
214	2	12.667	DEFGHIJKLMNOP
226	2	12.333	EFGHIJKLMNOP
227	2	12.333	EFGHIJKLMNOP
230	1	12.207	FGHIJKLMNOP
204	2	11.933	GHIJKLMNOP

208	2	11.667	HIJKLMNOP
209	2	11.667	HIJKLMNOP
211	2	11.667	HIJKLMNOP
203	2	11.5	IJKLMNOP
227	1	11.35	JKLMNOP
207	2	11.333	JKLMNOP
210	2	11.333	JKLMNOP
223	1	11.267	KLMNOP
224	1	11.167	KLMNOP
212	2	11	KLMNOP
228	1	10.867	KLMNOP
206	2	10.667	LMNOP
226	1	10.667	LMNOP
230	2	10	MNOP
225	1	9.9	NOP
229	1	9.39	NOP
228	2	8.667	OP
202	**2**	**8**	**P**

Table 12: Analysis of variance of Thousand Grain Weight

Source	DF	SS	MS	F	P
Rep	2	52.1	26.069		
Var	29	17768.4	612.703	20.1**	0
Tr	1	364.1	364.089	11.94	0.0008
Var*tr	29	17665	609.139	19.98*	0
Error	118	3597.1	30.483		
Total	179	39446.7			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance; *significance.

Table 13: LSD All-Pair wise Comparisons Test of TGW for var*tr

Varieties	Treatment	Mean	Homogeneous Groups
216	1	61.937	A
209	1	56.57	AB
217	1	55.3	AB
220	1	51.63	BC
211	1	51.107	BCD
215	1	50.033	BCDE
222	1	49.273	BCDEF
201	1	45.09	CDEFG
202	1	43.495	CDEFGH
221	1	42.467	DEFGHI
208	1	41.69	EFGHI
214	1	41.597	EFGHIJ
203	1	40.83	FGHIJK
210	1	40.597	FGHIJK
219	1	40.55	FGHIJK
204	1	39.285	GHIJK
213	1	39.25	GHIJK
205	1	38.423	GHIJK
207	2	38.017	GHIJK
230	2	37.603	GHIJK
206	1	37.55	GHIJK
229	2	37.02	GHIJK
207	1	37	GHIJK
206	2	36.887	GHIJK
221	2	36.78	GHIJK
220	2	36.717	GHIJK
209	2	36.687	GHIJK
202	2	36.42	GHIJK
215	2	36.323	GHIJK
226	2	36.26	GHIJK
212	2	36.11	HIJK
214	2	36	HIJK
217	2	35.97	HIJK
225	2	35.943	HIJK
219	2	35.93	HIJK
211	2	35.827	HIJK
218	2	35.827	HIJK
205	2	35.823	HIJK
203	2	35.51	HIJK
208	2	35.203	HIJK
216	2	35	HIJK
213	2	34.85	HIJK
204	2	34.683	HIJK
224	2	34.643	HIJK
228	2	34.44	IJK
223	2	34.367	IJK
218	1	34.31	IJK
227	2	34.29	IJK
222	2	34.107	IJK
210	2	33.873	IJK
212	1	32.673	JK
201	**2**	**32.567**	**K**
229	1	2.07	L
225	1	2.067	L
230	1	1.84	L
226	1	1.803	L
227	1	1.62	L
223	1	1.497	L
228	1	1.413	L
224	1	1.377	L

Table 14: Analysis of Variance Table for Grain weight

Source	DF	SS	MS	F	P
Rep	2	4.3	2.13		
Var	29	4499.9	155.17	14.99**	0
Tr	1	9850.1	9850.07	951.77**	0
Var*tr	29	6420.7	221.4	21.39*	0
Error	118	1221.2	10.35		
Total	179	21996.1			

DF=Degree of Freedom, SS= Sum of square, Ms= Mean of square: ** Highly significance; *significance

crop yield (Mudasir et al., 2021; Nadeem et al., 2022; Zafar et al., 2020; Zafar et al., 2022).

Grain Yield Per Spike

Number of grain yield per spike is most affected yield component and considered as most important factor under drought condition. Analysis of variance is given in Table 14. Comparison test for G x E is given in Table 15. Reduction rate decreases at genotype 216 (3.367). Grain yield per spike shows highly reduction percentage under drought stress (Kamal et al., 2019; Razzaq et al., 2020).

Conclusion

Results has showed that genotype 213 has minimum reduction in traits like plant height, genotype 228 show minimum reduction in number of tillers, genotype 215 shows minimum reduction in trait like spike length, genotype 217 shows minimum reduction in spikelets per spike, minimum reduction rate in traits like peduncle length in genotype 217, genotype 201 shows minimum reduction in trait like thousand grain weight and genotype 216 in grain yield per plant. Therefore, in future by using advanced breeding techniques, these genotypes

Table 15: LSD All-Pair wise Comparisons Test of GY for var* tr

Varieties	Treatment	Mean	Homogeneous Groups
226	1	43.617	A
225	1	43.563	A
224	1	41.72	AB
227	1	40.213	ABC
229	1	39.467	ABC
228	1	37.427	BC
223	1	36.357	CD
230	1	31.823	D
219	1	23.88	E
205	1	21.783	EF
222	1	18.717	EFG
207	1	18.15	FGH
210	1	17.757	FGHI
221	1	16.917	FGHI
218	1	16.553	GHI
211	1	16.547	GHI
206	1	16.063	GHIJ
204	1	16.03	GHIJ
202	1	15.74	GHIJK
208	1	15.723	GHIJK
220	1	15.66	GHIJK
203	1	15.05	GHIJKL
209	1	14.72	GHIJKL
216	1	14.62	GHIJKLM
212	1	13.673	GHIJKLMN
214	1	13.61	GHIJKLMN
201	1	13.055	HIJKLMN
213	1	12.677	IJKLMNO
204	2	11.333	JKLMNOP
215	1	11.327	JKLMNOP
217	1	11.077	JKLMNOPQ
203	2	10.667	KLMNOPQR
202	2	10	LMNOPQRS
201	2	9.9	LMNOPQRS
218	2	9.5	MNOPQRST
205	2	9.333	NOPQRST
214	2	9.2	NOPQRSTU
212	2	9	NOPQRSTU
215	2	8.867	NOPQRSTU
230	2	8.667	NOPQRSTU
217	2	8.533	NOPQRSTUV
221	2	7.767	OPQRSTUV
208	2	7.667	OPQRSTUV
213	2	7.5	OPQRSTUV
229	2	7.44	PQRSTUV
228	2	7.093	PQRSTUV
206	2	7	PQRSTUV
222	2	6.9	PQRSTUV
220	2	6.733	PQRSTUV
210	2	6.5	PQRSTUV
209	2	6.167	PQRSTUV
223	2	6.1	QRSTUV
224	2	5.6	RSTUV
207	2	5.5	RSTUV
219	2	5.1	STUV
211	2	5	STUV
225	2	4.633	TUV
227	**2**	**4.533**	**TUV**
226	2	4.067	UV
216	**2**	**3.367**	**V**

genotypes play an important role to provide way to developed the drought resistance cultivars to meet the challenge of water scarcity for agriculture sector in Pakistan.

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