Journal homepage www.jzs.uos.edu.krd
Journal of ZankoiSulaimani
Part-A- (Pure and Applied Sciences)

Grain yield and its components stability of bread wheat genotypes under rainfed conductions

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Article info
Original: 01/12/2017
Revised: 31/01/2018
Accepted: 06/02/2018
Published online:

Key Words:
Bread wheat
yield components, stability
genotype × environment interaction regression

Abstract

Ten bread wheat genotypes (Saraa-1, Sham-4, Maxipak,Babaga-3, Jawhir-3, Sale, NS732, REGAA6-1, QAF2AA-3 and IPA-95) were sown during 2015-2016 growing season at three locations (Sulaimani, Erbil and Duhok) under two sowing dates (1 November and 1 December). Randomized Complete Block Design was used with three replications to estimate the stability of these genotypes. Three stability parameters (variance across environments, regression coefficient Bi and variance of deviation from regression Sdi) were used to identify the stability in yield and its components .The results showed that the genotypes Babaga-3 and Jawhir-3 had the best values according to stability parameters, indicating their wide adaptability over different environments and be considered as favored wheat genotypes under variable rainfall conditions in Iraq. The other genotypes gave a high stability, performance not superior in yield and other traits, as other superior traits could be introduced to other genotypes in the improvement breeding program.

Introduction

Wheat is one of the most important cereal crop in Kurdistan region /Iraq, and is as food for a large part of the world population. Rizkalla *et al.* (2012) ***[1]*** reported that the increasing wheat production is an important goal to reduce the gap between production and consumption. This can be achieved by developing high yielding varieties, application of improved agro-techniques and cultivating wheat in newly reclaimed soils. It is also important to mention that the success of new varieties must show high performance for yield and yield components. Plant breeders in count genotype X environment interaction (G× E) when testing varieties across a number environments. Sial *et al.* (2009)***[2]*** found a high effect of environment factors during various stages of crop growth, thus genotypes differ widely in their response to environments. Some genotypes produce a highly specific response to particular are more important as the interaction plays significant role in the expression of the performance of different genotypes at different locations. According to Lin *et al.* (1986) ***[3]***, the yield stability represent consistency of genotype performances over time while, Ashraf *et al*. (2001) ***[4]*** indicated that the adaptability of variety over diverse environment is usually tested by the degree its interaction with different growing environments. Variety or genotype is considered to be more adaptive or stable one if it has high mean yield but low degree of fluctuation in yielding ability when grown over diverse environments. Several researchers studied the stability of yield and yield components

under different locations or time ***[5, 6, 7, 8, 9, 10]***.The most common method have been proposed by Eberhart&Russell (1966) ***[11]***for estimating adaptability and stability parameter, They consider genotype stable if it have a unit regression over the environments (b=0) with non deviated regression from zero (sd^2=0).Therefore, a genotype with high mean yield over the environment, unit regression coefficient (b=1) and deviated regression (sd^2=0)will most stable genotype. This study was attempted to investigate the adaptation of ten bread wheat genotypes under different locations and planting dates during the growing season 2015-2016.

Materials and Methods

A field experiment consisted of ten wheat genotypes (Table 1a) was applied under six environments, within three locations of (Sulaimani, Erbil and Duhok), each location had two environments (Table1b). Two planting dates Nov.1st and Dec.1st during 2015-2016 at all the three locations (The experiment was Randomized Complete Block Design (RCBD)with three replications for each location, each plot comprised two rows of three meter long with 30 cm wide. Seeding rate of120kg $ha^{-1}$was use. The recommended practices of wheat production was followed throughout the growing season. Data were collected from each plot on ten plants selected randomly for each genotype, Number of days from sowing to flowering, plant height ,number of grains $spike^{-1}$,1000-grainweight, biological yield and grain yield (t ha^{-1}) were recorded. The means treatments were compared using Duncan Multiple Rang Test(DMRT). Analysis of variance for each environment and pooled analysis over environments were computed. stability parameter was computed according to the following concepts of stability.

1-Variance across environments.

$$\sum \quad v = \frac{\sum(yij - xi.)2}{9-1}$$ (Lin *et al.* (1986) ***[3]***

2-Stability parameters was computed according to Eberhart and Russell (1966)***[11]***.

Regression Coefficient and deviation from regression were calculated ,and used as stability parameters for evaluating the stability over environments.

A genotype, which has high mean of each characters regression coefficient (Bi) close to unity with s^2di values not significantly different from zero is defined as table genotypes. The test of hypothesis using F.test as follows:

1-Ho:E liner = 0. $F= \frac{Ms(Elinear)}{Mspooleddeviation}$

2-Ho:(GxE) linear =0 $F= \frac{Ms(GxE)linear}{Mspooledeviation}$

3-Ho:Ms pooled deviation=0 $F= \frac{Mspooleddiviation}{Mspooledерror}$

4-Ho:s^2d = 0 $F= \frac{Ms(xi)gi}{Mspooledерror}$

5- Bi = 1 $+ = \frac{Bi-1}{SBi}$ $SBi = \frac{Ms(Xi)gi}{Sxx.}$

Table-1a: Pedigree and origin of wheat genotypes

code	Pedigree	Origin	Code	Pedigree	origin
G1	Saraa-1	ICARDA	G6	Sale	ICARDA
G2	Sham-4	Agri-Res.cent-Erbile	G7	NS732	ICARDA
G3	Maxipa	Agri-Res.cent-Erbile	G8	Regaa 6-1	ICARDA
G4	Babaga-3	ICARDA	G9	QAF2AA-3	ICARDA
G5	Jawhir -3	ICARDA	G10	IPA-95	IPA- center

Table-1b:The environments tested in Kurdistan-Iraq

Location	*Environment –Code*	*Sowing date*
Sulaimani	*E1*	*Nov.1st.2015*
	E2	*Dec.1st. 2015*
Erbil	*E3*	*Nov.1st.2015*
	E4	*Dec.1st. 2015*
Duhok	*E5*	*Nov.1st.2015*
	E6	*Dec.1st. 2015*

Results and Discussion

Mean square analysis for the ten genotypes evaluated under six divergent environments are given in Table 2.The differences among the environments were highly significant for all studied traits ,also the mean square of genotypes and their interactions with environments found to be highly considerable for the whole of studied traits with the exception of days to flowering. For days to flowering as presented in Table 3, of the environment was ranged from 103.30 days for E4 environment to 145.90 days for five environments. According to results in the same Table, the earliest genotype was No.8, it recording 122.8 days while the latest genotype was No.10 which recorded 130.9 days.

For the interaction between genotypes and environments the earliest genotypes was No.1 and 2 under environment E4 whilst, the latest one was the genotypes No.10 under E5 and recorded 150.0 days. Early flowering which show in Erbil (heat environment) with the late sowing (probably the plant exposure the plant to high temperature) over all environment and genotypes could be due to the affecting with high temperature compared to others. Comparable results were showed by ***[12, 13, 14, 15]***.

Table- 2: Mean square(Ms)according to Eberhart and Russell (1966) analysis of the ten wheat genotypes across six environments.

SOV	*df*	*Ms*					
		Days to flowering	*Plant height cm*	*No of grain spike^{-1}*	*1000.grain weight (g)*	*Biological yield t/h*	*Grain yield t ha^{-1}*
Environment(E)	*5*	*7133.56* **	*2641.72***	*302.46***	*285.71***	*1919.80***	*49.60***
r(e)	*12*	*1.4*	*36.06*	*1.70*	*2.26*	*0.45*	*0.07*
Genotypes(G)	*9*	*80.27 ***	*1866.31***	*127.68***	*113.86***	*15.19***	*5.28***
E x G	*45*	*20.44*	*184.07***	*92.86***	*28.71***	*23.81***	*3.83***
Error	*108*	*1.12*	*20.20*	*1.06*	*2.66*	*0.38*	
Total	*179*						

,,Significant at the 0.05 and 0.01 levels of probability, respectively.*

Table- 3: Mean days to flowering of the ten genotypes evaluated under six environments.

Env. Geno	*E1*	*E2*	*E3*	*E4*	*E5*	*E6*	*Mean*
G1	*143.67 cde*	*120.33 t-u*	*124.0 r*	*100.0 z*	*147.0 b*	*130.37 opg*	*127.55 c*
G2	*142.00 ef*	*116.0 w*	*123.3 rs*	*100.0 z*	*144.67 c*	*132.33 l-n*	*126.38 de*
G3	*141.33 f*	*115.67 w*	*122.0 St*	*102.0 z*	*144.67 c*	*134.0 kl*	*126.61 de*
G4	*142.33 def*	*114.33 vw*	*122.0 st*	*102.0 z*	*147.33 b*	*132.33 l-n*	*126.72 de*
G5	*139.33*	*118.33*	*122.67*	*102.0*	*149.67*	*130.0*	*127.0*

	gh	*v-y*	*Rs*	*z*	*a*	*pg*	*cd*
G6	*133.67*	*117.33*	*119.67*	*105.0*	*144.0*	*135.0*	*125.7*
	klm	*w-z*	*Uv*	*zy*	*cd*	*jk*	*e*
G7	*142.33*	*119.33*	*129.0*	*105.5*	*147.0*	*132.0*	*129.1*
	def	*uvw*	*G*	*zy*	*b*	*nom*	*b*
G8	*136.67*	*117.33*	*117.67*	*102.0*	*140.67*	*122.67*	*122.8*
	is	*w-z*	*w-z*	*z*	*fg*	*rs*	*f*
G9	*138.33*	*118.67*	*122.67*	*103.0*	*144.0*	*131.67*	*126.3*
	hi	*u-x*	*Rs*	*zy*	*cd*	*onp*	*de*
G10	*141.33*	*116.67*	*130.67*	*112.0*	*150.0*	*135.0*	*130.9*
	f	*yz*	*o-g*	*wz*	*a*	*jk*	*a*
Mean	*140.09*	*117.40*	*123.3*	*103.30*	*145.90*	*131.5*	
	b	*e*	*d*	*f*	*a*	*c*	

Means followed by different litters are significantly different from each other at p ≥0.05

Concerning plant height Table 4, average of the environments was ranged from 91.76 cm for E6 to 117.23 for E1. The tallest genotype was G8, that recorded 122.33 whereas G 10 was , the shortest was G10 (91.94 cm). For the interaction between genotypes and environment the tallest genotype was G8under E1while, shortest genotype was G10 under E6. These results were in agreement with the results proved by A1-otak, 2010 who found that the delaying sowing data caused a decrease in plant height. Data presented in Table 5 referred to the effect of interaction between genotypes and environments, for number grains per spike, the means of the environments were ranged from 33.84 grains for E1 to 40.46 grains for E5.As the genotype. The genotypes (G1 and G2had) recorded the heights number of grains 40.92 and 40.66 respectively, while, the lowest grains refer to G6 giving (32.90) grains.The best genotype was G4 under E5 whilst the least genotypes were both G5 and G6 under E2. Similar demonstrated by Amin *et al.* (2005) ***[13]***.

Table- 4: Mean of plant height of the ten wheat genotypes evaluated under six environments

Env.	***E1***	***E2***	***E3***	***E4***	***E5***	***E6***	***Mean***
Geno.							
G1	*102.67*	*93.33*	*101.0*	*98.33*	*87.67*	*83.67*	*94.44*
	j-h	*p-t*	*i-p*	*i-r*	*t-v*	*u-w*	*e*
G2	*104.67*	*93.33*	*96.33*	*87.67*	*87.67*	*93.33*	*94.50*
	g-L	*o-t*	*L-t*	*t-v*	*t-v*	*o-t*	*e*
G3	*133.0*	*99.67*	*100.0*	*95.67*	*106.33*	*82.67*	*102.88*
	bc	*k-g*	*k-g*	*o-t*	*g-i*	*v-w*	*d*
G4	*123.0*	*121.33*	*107.67*	*103.67*	*88.33*	*94.33*	*106.38*
	de	*dc*	*gh*	*g-j*	*s-v*	*o-t*	*c*
G5	*125.67*	*123.33*	*99.67*	*99.67*	*92.67*	*99.33*	*106.72*
	cd	*de*	*k-g*	*k-g*	*g-t*	*i-g*	*c*
G6	*132.67*	*131.67*	*111.33*	*107.0*	*102.33*	*106.0*	*115.16*
	bc	*bc*	*fg*	*g-i*	*j-o*	*g-j*	*b*
G7	*97.33*	*91.33*	*95.33*	*89.67*	*102.0*	*78.67*	*92.29*
	l -r	*g-u*	*o-t*	*r-u*	*k-o*	*wy*	*e*
G8	*140.67*	*134.0*	*118.0*	*121.33*	*117.67*	*102.33*	*122.33*
	a	*ab*	*def*	*de*	*def*	*i-o*	*a*
G9	*117.33*	*116.0*	*105.33*	*94.67*	*97.0*	*102.67*	*105.50*
	def	*ef*	*g-k*	*o-t*	*L-s*	*j-h*	*cd*
G10	*95.33*	*95. 0*	*108.0*	*97.0*	*81.67*	*74.67*	*91.94*
	o-t	*o-t*	*gh*	*l-s*	*v-x*	*x*	*e*
Mean	*117.23*	*110.30*	*104.26*	*99.46*	*96.33*	*91.76*	
	a	*b*	*c*	*d*	*d*	*e*	

Means followed by different letters are significantly different from each other at p≥ 0.05

Table- 5: Mean of number grains per spike of the ten wheat genotypes evaluated under six environments.

Env. . Geno.	E1	E2	E3	E4	E5	E6	Mean
G1	35.7	36.57	42.67	42.13	55.0	34.0	40.92
	j-g	j-n	d-f	ef	B	p-w	a
G2	35.83	33.90	38.60	37.07	34.0	35.67	36.01
	j-g	g-w	g	g-k	p-w	j-n	bc
G3	36.0	33.20	38.33	34.93	42.0	30.67	36.18
	j-p	u-y	gn	o-s	Ef	w-y	bc
G4	34.77	32.07	32.53	31.27	58.0	54.33	40.66
	o-t	u-y	r-v	z	A	b	a
G5	34.30	28.63	34.47	36.53	34.0	42.0	35.21
	p-g	y	o-t	j-n	p-w	ef	d
G6	32.23	28.63	35.73	32.13	33.0	34.33	32.90
	u-y	y	o-g	u-y	u-y	p-g	e
G7	30.03	29.70	37.80	43.0	40.0	31.67	35.55
	y	y	ghi	de	F	w-y	Cd
G8	31.33	32.07	37.0	36.80	35.0	46.33	36.47
	z	u-y	g-l	g-m	o-g	c	e
G9	32.77	30.80	31.40	37.67	33.0	33.67	33.15
	u-y	z	z	g-i	u-y	r-x	e
G10	36.40	29.53	45.87	43.47	34.0	32.0	36.65
	j-o	y	c	d	p-w	w-y	b
Mean	33.84	31.51	37.44	37.50	40.46	34.46	
	c	d	b	b	a	b	

Means followed by different letters are significantly different from each other atp ≥ 0.05

Table 6 clarified the 1000-grain weight mean of ten wheat genotypes evaluated in eight environments. This trait exhibited detected a range of different environments that ranged between 29.72g for the environment 2 to 38.20 g for environments 3, Where ever the maximum 1000-grain weight recorded by G4 (37.78) g and the minimum value for this trait was 30.39 recorded by G1. For the interaction effect the same Table noticed that the heaviest 1000-grain weight was obtained by G4 under environment E5. Whilst, the lowest 1000-grain weight recorded by G1 with the value 25.50 g under environment four. From the above results. Tables 6 and 7, the G4 was superior in number of grain spike^{-1} and 1000-grain weight and these traits were more effective in wheat yield. For biological yield Table 7 showed that the average of yield ranged from 11.36t ha^{-1}for environment two to 31.28 t ha^{-1} for environment five. Regarding the G8 gave the maximum biological yield 20.22 t ha^{-1}while,the G1 exhibited the lowest value (17.32) t ha^{-1}.For the interaction effect the G7 recoded the heaviest biological yield (37.15 t ha^{-1}) under environment five and the lightest biological yield was recorded by genotype ten with the value 10.87 t ha^{-1} under environment two. Similar results were also reported by Rizlalla *et al*. (2010)***[1]***.

Table- 6: Mean of 1000-grain weight of the ten wheat genotypes evaluated under six environments

Env. Geno.	E1	E2	E3	E4	E5	E6	Mean
G1	31.63	26.73	33.0	25.50	37.32	26.30	30.39
	i-n	v-x	o-g	wx	cdef	v-x	e
G2	35.81	29.06	36.13	27.87	39.48	33.27	33.60
	i-j	r-n	i-j	u-x	bc	i-n	c
G3	29.45	30.73	38.77	28.73	32.90	29.40	31.66
	r-u	o-u	bcd	s-w	o-g	r-u	d

G4	*34.54*	*29.31*	*39.73*	*35.70*	*45.65*	*41.78*	*37.78*
	i-k	*r-u*	*bc*	*i-k*	*a*	*B*	*a*
G5	*34.44*	*31.40*	*41.33*	*36.03*	*33.77*	*35.93*	*35.48*
	i-m	*o-t*	*b*	*i-j*	*i-n*	*i-j*	*b*
G6	*36.34*	*30.29*	*41.40*	*31.17*	*34.90*	*30.50*	*34.09*
	c-h	*o-n*	*b*	*o-t*	*i-k*	*o-u*	*c*
7	*33.10*	*29.79*	*36.80*	*30.47*	*33.18*	*22.10*	*30.40*
	i-g	*v-x*	*c-h*	*o-u*	*i-g*	*X*	*e*
G8	*33.69*	*34.08*	*40.97*	*31.67*	*32.88*	*37.90*	*35.19*
	i-n	*i-m*	*b*	*o-s*	*0-g*	*cde*	*b*
G9	*34.43*	*24.29*	*37.10*	*32.57*	*28.90*	*31.89*	*32.36*
	i-m	*r-u*	*c-g*	*L-r*	*s-w*	*o-L*	*d*
G10	*30.34*	*29.59*	*36.77*	*28.33*	*29.33*	*29.0*	*30.55*
	o-u	*r-u*	*c-h*	*s-w*	*r-u*	*r-u*	*e*
Mean	*33.58*	*29.72*	*38.20*	*30.79*	*34.83*	*31.79*	
	c	*e*	*a*	*e*	*b*	*d*	

Means followed by different letters are significantly different from each other at p ≥ 0.05

Table-7: Mean of biological yield (t ha^{-1}) of the ten wheat genotype evaluated under six environments

Env. Geno.	***E1***	***E2***	***E3***	***E4***	***E5***	***E6***	***Mean***
G1	*13.38*	*14.43*	*13.47*	*15.27*	*23.62*	*23.80*	*17.32*
	x	*g-t*	*u-x*	*o-s*	*g*	*G*	*e*
G2	*14.23*	*12.29*	*15.47*	*14.o7*	*26.99*	*22.41*	*17.57*
	t-v	*y*	*o-n*	*s-w*	*e*	*H*	*e*
G3	*13.23*	*11.64*	*16.67*	*15.93*	*34.12*	*22.46*	*19.00*
	u-x	*y*	*mn*	*n-p*	*b*	*H*	*cd*
G4	*15.30*	*12.98*	*19.87*	*13.63*	*25.71*	*25.66*	*18.85*
	o-r	*xyz*	*ij*	*u-x*	*f*	*F*	*d*
G5	*11.69*	*8.55*	*17.95*	*15.67*	*34.17*	*25.39*	*18.89*
	y	*z*	*kl*	*o-g*	*b*	*F*	*d*
G6	*11.58*	*10.88*	*17.33*	*13.82*	*32.64*	*31.67*	*19.65*
	y	*y*	*Lm*	*u-x*	*c*	*C*	*b*
G7	*11.29*	*8.74*	*20.20*	*12.93*	*37.15*	*26.03*	*19.35*
	y	*z*	*i*	*xyz*	*a*	*Ef*	*bc*
G8	*11.33*	*12.42*	*18.87*	*14.10*	*30.58*	*34.05*	*20.22*
	y	*yxz*	*jk*	*t-v*	*d*	*b*	*a*
G9	*13.64*	*10.89*	*19.73*	*15.0*	*33.74*	*25.87*	*19.81*
	u-x	*y*	*ij*	*p-t*	*b*	*F*	*b*
G10	*13.03*	*10.87*	*16.37*	*14.67*	*34.10*	*24.22*	*18.87*
	u-x	*y*	*o-n*	*g-u*	*b*	*g*	*b*
Mean	*12.87*	*11.36*	*17.54*	*14.50*	*31.28*	*26.15*	
	e	*f*	*c*	*d*	*a*	*b*	

Means followed by different litters are significantly different from each other at p ≥ 0.05

Results in Table 8 revealed mean grain yield of the ten wheat genotypes evaluated under six environments. The average of environments was ranged from 5.10 t ha^{-1} for environment two to 7.79 t ha^{-1} for environment five. The genotype one (Saraa-1) gave the highest grain yield were producing 6.63 t ha-1 and followed by genotypes four and three those recorded 6.58 and 6.52 t ha^{-1} respectively. Whereas the lowest grain yield was recorded by genotype seven which recorded(5.17 t ha-1). Depending on the interaction between genotype and environment, the genotypes seven gave the lowest grain yield 3.55 t ha^{-1} under environment two while, the highest grain yield refers to genotypes 3 and 5 Maxipak and Jawhir-3 giving 10.0 and 9.95 t ha $^{-1}$

respectively under E5. These results demonstrate that Duhok Location with early sowing data had the best records. The researchers ***[2, 10, 14]*** obtained similar results.

Table- 8: Mean of grain yield(t ha^{-1}) of the ten wheat genotypes evaluated under six environments.

Env. ***Geno.***	***E1***	***E2***	***E3***	***E4***	***E5***	***E6***	***Mean***
G1	*6.10*	*6.39*	*4.15*	*6.46*	*8.69*	*8.o3*	*6.63*
	L-n	*ijk*	*s-v*	*hij*	*e*	*E*	*a*
G2	*6.49*	*5.51*	*5.38*	*4.28*	*4.52*	*5.44*	*5.26*
	Hij	*p-s*	*u-w*	*s-v*	*s-v*	*r-u*	*f*
G3	*6.19*	*5.04*	*6.36*	*4.58*	*10.0*	*6.95*	*6.52*
	k-m	*vx*	*ijk*	*s-v*	*a*	*g*	*a*
G4	*7.36*	*5.76*	*5.18*	*5.19*	*6.5*	*9.49*	*6.58*
	F	*o-r*	*uvw*	*t-v*	*hij*	*b*	*a*
G5	*5.80*	*4.14*	*5.45*	*5.10*	*9.95*	*9.16*	*6.59*
	o-n	*x*	*p-s*	*t-v*	*a*	*c*	*a*
G6	*5.47*	*5.19*	*5.59*	*3.43*	*8.86*	*9.55*	*6.34*
	p-s	*uvw*	*p-s*	*vzx*	*d*	*b*	*b*
G7	*4.17*	*3.55*	*5.07*	*3.97*	*8.04*	*5.74*	*5.15*
	Lyx	*y*	*vxw*	*y*	*e*	*o-r*	*f*
G8	*5.16*	*5.75*	*5.51*	*4.29*	*8.45*	*7.62*	*6.17*
	t-v	*o-r*	*p-s*	*x*	*d*	*f*	*c*
G9	*6.25*	*4.95*	*4.32*	*5.27*	*6.66*	*7.52*	*5.82*
	i-L	*w*	*x*	*s-v*	*ghi*	*f*	*e*
G10	*5.95*	*4.78*	*6.82*	*5.87*	*5.95*	*6.65*	*6.00*
	o-n	*w*	*gh*	*0-n*	*o-n*	*ghi*	
Mean	*5.95*	*5.10*	*5.38*	*4.84*	*7.79*	*6.11*	
	c	*e*	*d*	*f*	*a*	*b*	

Means followed by different letters are significantly different from each other at $p \geq 0.05$

Table 9 exhibited the stability analysis for studied traits of ten wheat genotype evaluated under six environments. It is realized that the genotypes differ considerably for all studied traits except number of grains $spike^{-1}$ and biological yield. Also the results in the same Table indicated that the E- liner was remarkable for the whole of studied characters which referred to the genetic control of genotype response to different environments.The genotypes by interaction components divided into linear (environments and genotype x environment) and linear for pooled deviation. The mean square for pooled deviation tested against pooled error dictated that the differences in stability were due to deviation from linear regression. Similar trend were also by [***14, 15, 16***, ***17***].

The results in Table 10 exhibited the mean values of days to flowing, plant height and number of grains spike-1 and some stability parameter for ten genotypes tested under six environments. For the days to flowering, six genotypes (G1 to G5) can be considered to be more stable under varying environments, because it noticed non signified .Significant deviation from regression and bi values were more than one, while the genotypes from 6 to 10 , showed non significant value of bi < and sdi,indicating that these genotype have a good response to unsuitable environment regarding plant height ,the genotypes ,3 ,4 ,5 ,6 and 8 gave the longest plants ranged between 162.88 to 122.2 and the same genotypes recorded close bi values . Hence these genotypes are more stabilizing than others genotypes according to Eberhartand Russell (1966) [***11***]. Concerning to number of grains spike -1, the genotype 1 and 4 exhibited the highest number and recorded 40.93 and 40.6 6 grains respectively, and the same genotypes had bi values of 1.76 and 2.52 , it means that the genotypes (1,and 4) were more response to a good environments. For 1000-grain weight the genotypes 4 gave the maximum value of 37.78 g. The same table showed G1,G2,G3,G4,G6 and G7 to have bi value unity, non significant deviation from regression, which indicates that, these genotypes

are most stabile the different cross environments, while the others genotypes gave bi value less than one. Means not stabile in different environments.

For biological yield, Table 11 showed that the genotypes 5 to 10 gave bi value more than one decimal numbers compared with the other genotypes (1to 4), according to this parameter these genotypes(5 to 10) response to a good environments and they gave the highest value for this trait(20.22 t ha).

Results in Table 11 indicated that the genotypes 1, 6 , 4 , 5 , 6 and 8 gave the highest grain yield. The genotypes 3, 5, 6,7 and8 have bi value more than one thus these genotypes respond to a good environments while the other genotypes have bi value Less than one, means these genotypes were not stabile to all environments.

Table- 9: Stability analysis the studied traits of ten wheat genotypes evaluated under six environments

		Ms					
S o v	**df**	**Days to flowering**	**Plant height cm**	**No. of grains spike^{-1}**	**1000-grain weight (g)**	**Biological yield t ha^{-1}**	Grain yield t ha^{-1}
Gen	*9*	*26.75***	*622.10***	*42.56*	*37.95***	*5.06*	*1.76**
E +(GxE)	*50*	*249.9***	*143.28***	*37.94*	*18.13**	*71.13***	*2.80***
E-liner	*1*	*12189.28***	*4402.87***	*504.10***	*476.19***	*3199.67***	*82.68***
(G x E)	*9*	*8.71*	*72.72*	*25.43*	*2.92*	*20.32***	*2.83***
Pooled dev.	*4*	*5.70***	*52.66***	*29.1-0***	*10.11***	*4.35***	*0.79***
Pooled error	*120*	*0.376*	*6.73*	*0.35*	*0.88*	*0.129*	*0.01*

Table-10: Mean of days to flowering ,plant height and number of grain per spike and some stability parameters for ten wheat genotypes test under six environments .

Genotype	**Days to flowering**			**Plant height cm**			**Number of grains spike-1**		
	S^2di	**di**	**mean**	**S^2di**	**di**	**mean**	**S^2di**	**di**	**mean**
G1	*23.08*	*1.08*	*127.5*	*123.78*	*0.61*	*94.44*	*145.48*	*1.76*	*40.92*
G2	*9.40*	*1.07*	*126.38*	*66.95*	*0.55*	*94.50*	*11.40*	*0.20*	*36.01*
G3	*12.74*	*1.04*	*126.61*	*493.70*	*1.43*	*102.88*	*71.95*	*0.82*	*36.18*
G4	*7.37*	*1.10*	*126.66*	*127.41*	*1.39*	*106.38*	*463.83*	*2.52*	*40.66*
G5	*14.76*	*1.06*	*127.0*	*212.97*	*1.32*	*106.72*	*55.97*	*0.85*	*35.21*
G6	*53.13*	*0.90*	*125.88*	*139.12*	*1.32*	*115.16*	*11.02*	*0.63*	*32.90*
G7	*14.93*	*0.97*	*129.16*	*259.66*	*0.37*	*92.29*	*69.25*	*1.11*	*35.53*
G8	*36.38*	*0.88*	*122.83*	*96.29*	*1.36*	*122.33*	*110.61*	*0.82*	*36.47*
G9	*4.12*	*0.94*	*126.38*	*134.24*	*0.84*	*105.50*	*24.43*	*0.32*	*33.15*
G10	*52.21*	*0.90*	*130.94*	*452.48*	*0.76*	*91.94*	*200.99*	*0.62*	*36.65*

Table- 11: Mean of 1000 grain weight, biological and grain yield and some stability parameters for ten wheat genotypes evaluated under six environment.

Genotype	**1000-grain weight (g)**			**Biological yield t ha^{-1}**			**Grain yield t ha^{-1}**		
	S^2di	**di**	**mean**	**S^2di**	**di**	**mean**	**S^2di**	**di**	**mean**
G1	*54.41*	*1.17*	*30.39*	*18.11*	*0.57*	*17.32*	*5.14*	*0.95*	*6.63*
G2	*40.20*	*1.11*	*33.60*	*2.89*	*0.71*	*17.57*	*3.12*	*-0.03*	*5.26*
G3	*18.60*	*1.05*	*31.66*	*24.80*	*0.99*	*19.0*	*4.76*	*1.28*	*6.52*
G4	*115.44*	*1.05*	*37.78*	*15.37*	*0.69*	*18.85*	*6.42*	*0.93*	*6.58*
G5	*24.67*	*0.80*	*35.48*	*10.88*	*1.16*	*18.89*	*1.43*	*1.79*	*6.59*
G6	*8.99*	*1.34*	*34.09*	*15.89*	*1.22*	*19.65*	*1.97*	*1.76*	*6.34*
G7	*58.21*	*1.29*	*30.40*	*17.96*	*1.32*	*19.38*	*3.05*	*1.08*	*5.17*
G8	*38.94*	*0.69*	*35.19*	*50.91*	*1.15*	*2.22*	*1.89*	*1.20*	*6.17*

G9	*29.91*	*0.62*	*32.36*	*5.92*	*1.06*	*19.81*	*1.87*	*0.74*	*5.82*
G10	*15.04*	*0.84*	*30.55*	*11.58*	*1.07*	*18.87*	*2.25*	*0.20*	*6.00*

Conclusion

From this study, we can conclude that the genotypes 4 and 6, had the best values according to the parameters of stability, they have a wide adaptability across different environments and be considered as good wheat genotypes under various of rain fall conditions in Kurdistan. The other genotypes were also given highest ability while, they were not superior traits can be transferred to other genotypes via hybridization breeding program .These results agreement with the results proved by other researchers ***[14, 9, 10].***

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