Performance of two and six row barley (Hordeum spp) genotypes under different dryland environments

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Abstract

Eight of barley pedigrees where compared to one six row adapted cultivar Acsad 12 and another six row adapted cultivar Acsad 14 in an field experiment at two locations of Erbil province (Einkawa and Koya) for three barley growth seasons during the period of 1993 – 1996, resulted in different effects on vegetative and reproductive growth in addition to yield and yield components as the significant best performance was at the third season 1995-1996 and in koya location while the lesser performance was at the first season and Einkawa location , most of the pedigrees overpassed the local well adapted control cultivars in many of the studied traits , especially as the two row pedigree P5 which yielded 610.39 g grains m^{-2} and 1569.4 g m^{-2} of biological dry mas followed non-significantly by the control Acsad 14 ,as well as the highest grain yield (754.93 g m^{-2})and biological yield (1650.9 g m^{-2}) were performed season3 and season 1 respectively .Koya location produced significant higher mean values of 541.72 gm^{-2} and 1560.9 gm^{-2} of grain and biological yield surpassing Einkawa location by 1.2% and 1.23% respectively.

Key words ; barley, genotypes, locations, seasons

أداء بعض التراكيب الوراثية من الشعير ذي الصفين والستة صفوف تحت ظروف مختلفة من الزراعة الجافة

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الخلاصة

اجريت تجربة حقلية في موقعي عينكاوة وكويسنجق ؟اربيل ذات الطبيعة المطرية شبه المضمونة ولمدة ثلاثة مواسم شتوية بين العامين 2013-2016 لمعرفة مدى ملائمة ثمانية خطوط وراثية من الشعير بنوعيه الست والاربعة صفوف مسنبطة حديثا مقارنة بالصنفين المزروعين أكساد 12 واكساد 14 من كل نوع وحسب التتابع . درست مجموعة من صفات النمو الخضرية والثمرية أضافة الى الحاصل ومكوناته . اظهرت التجربة تفوق موقع كويسنجق في معظم الصفات عدا مساحة ورقة العلم وطول السنبلة وتفوق الموسم الزراعي الثالث 2015-2016 في كل من الصفات ، ارتفاع النبات و ومساحة ورقة العلم ووزن الالف حبة وعدد حبوب السنبلة وحاصل الحبوب ، بينما تفوق الموسم الثاني 2014-2015 في صفات طول السنبلة وعدد السنابل في المتر المربع وتفوق الموسم الاول 2013-2014 في الحاصل البيولوجي فقط وذلك حسب توفر الامطار وملائمة توزيعها حسب مراحل النمو في كل موسم ، وتفوقت معظم التراكيب الوراثية على صنفي المقارنة عدا تفوق الصنف اكساد 12 في وزن الالف حبة وتفوق الصنف اكساد 14 في دليل المساحة الورقية و عدد ب\ور السنبلة والحاصل البيولوجي . وتظهر من النتائج مدى أمكانية الوصول الى أستنباط أصناف جديدة ملائمة للمنطقة لاغراض التغذية والعلف وربما الاهداف الصناعية ايضا تحت ظروف تهديدات الجفاف وشحة المياه المستقبلية .

الكلمات المفتاحية: التراكيب الوراثية ، الشعير ، الزراعة الجافة

Introduction

Barley (*Hordeum vulgare* L.) is one of the earliest domesticated crop . due to its tolerated growth to a wide range of geographical and edaphic environments plants (Zohary and Hopf, 2013). The genus Hordeum comprises from many species, which are spread throughout the world (Jacopsen and Bothmer.,1995). About all the northern uplands lay under the rain-fed areas with Mediterranean climate and including more than 53% of the arable lands .rainfall happens during the period from December to April of the next year to form suitable climate for winter cropping season, the mean annual rainfall in the semi insured region is about 350 mm rising to more than 600

mm in the insured rain regions.(Jaradat , 2002). Barley consists around 20% of the grown cereals in Iraq with fluctuated annual cultivated areas from half to one million hectares producing about one tone ha^{-1} following the scarcity of water and hesitating temperature from $40C^{o}$ to $-2C^{o}$ (FAO, 2014). The northern lacks ideal conditions of barley planting since the winter cropping benefits from winter rainfall. Barley production is affecting by both of the degree of security concerns and ruminant animals as consumers depending on barley as feed (Grain and Feed Annual 2017). Barley production in Iraq during the period from 2009 to 2013 increased about 27% at the end of the period then dropped back about 9% in the next year (FAO 2014).This research were achieved at barleys homeland as contribution in sustainable cereal production**.** Grain and biological yields are the last products aimed by the growers for their importance as food and feed , the two studied characters are modified through the common indices (harvest index) which can be estimated through many methods as that proposed by (Kemanian et al . 2007) .

Materials and Methods

An experiment was conducted at two locations (Einkawa and Koysanjaq (koya) / Erbil-Iraq) during three growing seasons (1993 -1994 , 1994-1995 and 1995-1996) testing four of each of six and two row barley pedigrees compared to the controls 6 row (Acsad 12) and 2 row (Acsad 14) cultivars (later C1 and C2) respectively, source of the genotypes was Einkawa research station in cooperation with FAO organization . Full details about the genotypes are listed in table (1a).

Table (1) Names, pop type, row-type ,origin and the codes used in the research text.

Name	Group	pop type	origin	province	3D coordinates			Code used
					X ° ‘ ‘’	Y ° ‘ ‘’	Z (m)	
6 ROW					longitude °	latitude	Altitude	
35385	ICB	LA	DZA	Albaydah	E00 32 18	N32 45 02	1150	P1
35398	ICB	LA	DZA	Sedi Bal Abbas	W00 30 00	N35 22 00	510	P2
36845	ICB	LA	NPL	Koel	E08 07 08	N27 25 46	1575	P3
37543	ICB	LA	LBY	Al jabal al axdar	E21 57 26	N32 38 48	830	P4
Acsad12	Check (control) 6 row barley cultivar							C1
2 Row								
20891	ICB	LA	Afg	Herat	E62 24 10	N33 47 20	1494	P5
35262	ICB	LA	Syria	Edlip	E36 58 00	N36 07 00	420	P6
131321	ICB	WE	Kaz	Chemkenz	E69 37 32	N42 21 19	610	P7
131417	ICB	LA	Kaz	Dahmabul	E73 09 92	N42 54 09	672	P8
Acsad 14	Check 2 row barley cultivar							C2

Soil analyses were achieved in the laboratory of Einkawa research station / Ministry of Agriculture / KRG /Iraq.(Table 1b)

Table (1b):Some physical and chemical properties of experimental soil at depth (0-30 cm):

Properties	Particle size distribution g kg^{-1} soil			Texture	pH	Total N%	Available		OM %
	Sand %	Silt %	Clay %				P ppm	K ppm	
Einkawa	13	42	45	Silty clay	7.32	0.20	3.4	100	0.9
Koysenjaq	12	39	49		7.26	0.15	4.1	111	2.1

Farm applications of fertilizers were achieved upon the local recommendations of the agricultural authority. Seed planting where done on rows with 20 cm equidistance spacing in (6m × 3 m) blocks, depended completely on rainfall.

Periodic records of climatic data were obtained from the on farm stations on both locations, the most obvious spatial variation were in rainfall amount and distribution across the months (Figure No. 1)

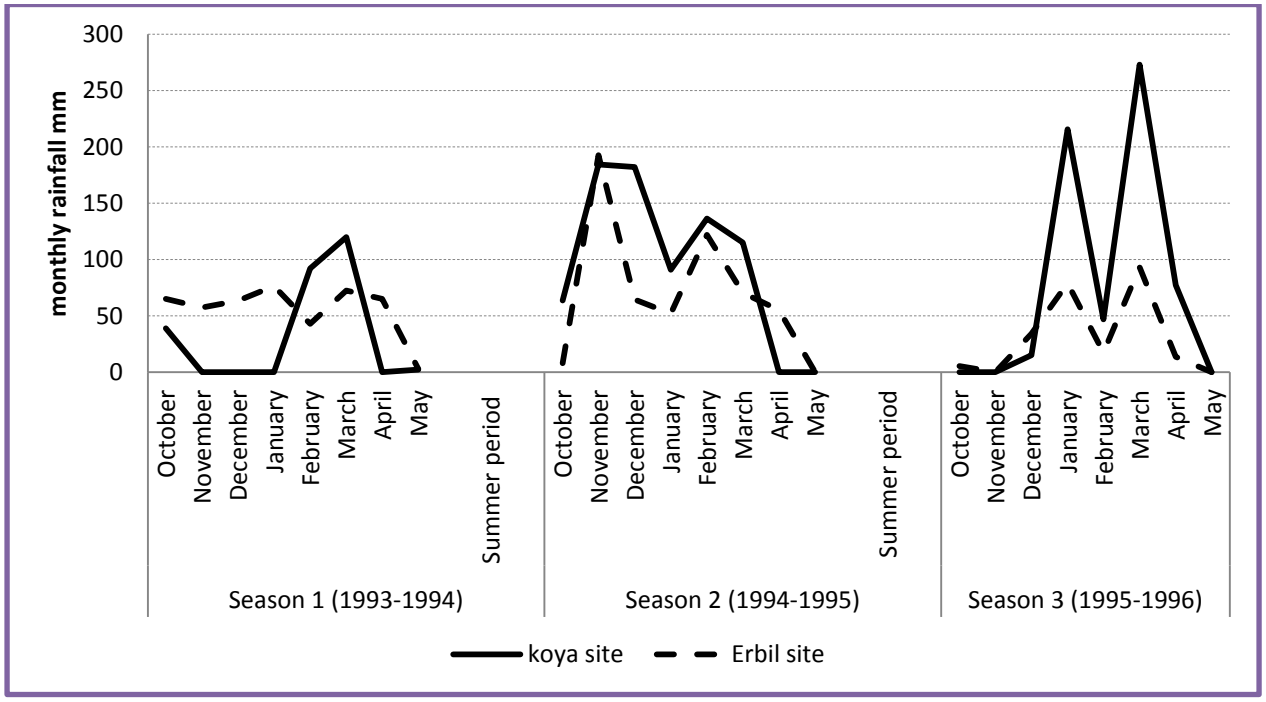

Figure No.1 shows the spatial and temporal distribution and rainfall amounts in Einkawa (Einkawa) and Koysinjiq (Koya) locations .

Data about plant height, flag leaf area , leaf area index , spike length, one thousand grain weight, grain number spike^{-1}, grain yield and biological yield were collected according to Caustin and Venus (1981) and Megersa et al (2015).

Statistical analysis achieved on the Randomized Complete Block designed (RCBD) experiment using SAS windows ver. 9.3 (SAS. 2005) according Tuckey's test of separated means for significance at ($p \leq 0.05$) level.

Results and discussion

The following tables demonstrate the significance responses ($p \leq 0.05$) of the studied 10 barley genotypes to years (growth seasons) , locations and their interactions on each of the vegetative growth, yield and yield component characters ; plant height (PH), flag leaf area(FLA) , leaf area index (LAI), spike length (SL),thousand grain weight (TGW), number of grains per spike (GS), number of spikes m^{-2} (SM) , grain yield m^{-2} (GY),biological yield m^{-2} (BY) and harvest index % (HI).

1- Effect of seasons:

Years 1993-1994 (season 1), 1994-1995 (season 2) and 1995-1996 (season 3) had different effects on the studied traits as shown in table (2) .Season 3 impact leaded to superior mean values of each of PH, FLA, LAI, SL, TGW, GS, GY, BY and HI, in common superior effects with season 2 on LAI, SL, TGW, GY and with season 1 in their significant effect on BY. The superiority of season 3 in most of the characters could be partly due to the availability of rainfall during the active growth

stages (establishment) at January and (elongation) at March. Uncertainties of precipitation amount and distribution results in un expected genotypic performances across the seasons (Palosuo et al 2015).

Table (2) : Effect of growing seasons on some vegetative, yield and yield components of 10 studied genotypes of barley.

Seasons / Characters		2013-14 (Season 1)	2014-15 (Season 2)	2015-16 (Season 3)	*Tuckey's MSD
Plant height cm	(PH)	80.48 b	72.52 c	106.58 a	2.403
Flag leaf area cm^2	(FLA)	12.94 b	13.30 b	17.13 a	2.487
Leaf area index	(LAI)	2.46 a	2.84 a	2.64 a	0.68 (ns)
Spike length	(SL)	7.70 b	8.35 a	8.21 a	0.342
Thousand grain weight g	(TGW)	33.78 b	40.34 a	40.62 a	2.061
Grain number $spike^{-1}$	(GS)	7.12 c	27.45 b	29.58 a	1.472
Number of spikes m^{-2}	(SM)	238.67 b	361.25 a	317.88 a	18.324
Grain yield g m^{-2}	(GY)	308.02 c	420.1 b	754.93 a	50.123
Biological yield g m^{-2}	(BY)	1650.9 a	1140.5 c	1441.9 b	84.205
Harvest Index	(HI)	0.19 a	0.39 a	0.52 a	0.224(ns)

***Means followed by the same letter aren't significantly differed.**

2- Effect of locations:

Einkawa location had significant superior effects on each of FLA, SL, and GSX, while Koya location has the superiority in most of the studied traits PH, LAI, THW, GS, SM, GY, BY and HI. The significant highest mean value of flag leaf area and leaf area index in Koya location (Table 3) could be the result of its significant effects on yield component traits TGW,GS, SM then on the yield traits GY,BY and HI , since the leaf is the central location of photosynthesis and dry matter production .Repeating of the experiment spatial different location and years contributes the creation of various combination of radiation and temperature .(Guinta et al 2009).

Table (3) : Effect of locations on some vegetative, yield and yield components of 10 studied genotypes of barley.

Locations / Characters		Einkawa	Koysingaq	*Tuckey's MSD
Plant height cm	(PH)	83.46 b	89.60 a	1.638
Flag leaf area cm^2	(FLA)	17.29 a	11.62 b	1.737
Leaf area index	(LAI)	2.70 a	2.59 a	0.466 (ns)
Spike length	(SL)	8.76 a	7.42 b	0.233
Thousand grain weight g	(TGW)	37.11 b	39.38 a	1.405
Grain number $spike^{-1}$	(GS)	21.60 a	21.17 a	1.003 (ns)
Number of spikes m^{-2}	(SM)	278.58 b	333.29 a	12.486
Grain yield g m^{-2}	(GY)	446.98 b	541.72 a	34.154
Biological yield g m^{-2}	(BY)	1261.3 b	1560.9 a	57.378
Harvest Index	(HI)	0.34 a	0.39 a	0.11 (ns)

***Means followed by the same letter aren't significantly differed.**

3- Response of Genotypes:

Most of the tested barley genotypes (named in table 1) exceed both of the control 2 rowed (acsad-12) and 6 rowed (acsad-14) barley cultivars in many of the studied traits as shown in table (4), whereas p6 (two row) produced significant taller plants , higher FLA ,longer SL and HI,

followed by p6 and p8 six row) genotypes that have higher significant performance in each of PH , FLA, TGW, GS, and grain yield. P6 and P8 produced 610.39 g and 520 g of seeds per square meter or 2.442 and 2.080 $kg.ha^{-1}$ respectively with average surplus yield of 26% to the well adapted check cultivars .in addition that most of the 6rowed genotypes over yielded all of the tested genotypes, this could be owed to the significant higher mean values of the superior cultivars in the mean values of the vegetative traits PH, FLA, and the yield components of TGW, GS. However the only non-significant trait was the leaf area index. the results followed the genetic variation among six and two rowed barley groups (Alqudah and Schnurbusch 2015).

4- Effects of Interactions:

Double and triple interactions among the studied factors; years or seasons (Y), locations and genotypes (named in table 1) had many significant and non-significant effects on the studied traits as detailed in below;

4-1 Interaction between Growing seasons and Locations (Y×L):

Table (5) postulates that in spite of the significant higher mean values of FLA, SL, TGW,**GS** produced from the interaction between Season2 and to produce the highest grain yield , the performance that could be achieved from the interactions between Season 3 with each of of Koya and Einkawa locations with mean values of grain yield amounted by 774.9 g m^{-2} and 734.97 g m^{-2} respectively resulted from significant higher mean values of PH, TGW,GS and GY .Einkawa location .

4-2 Interaction between Locations and Genotypes (L×G):

Only a pair of the 2rowed barley genotypes (p1 and p2) could achieve a slight superiority in grain yield production through their interaction effects with location Koya location as they produced 551$g.m^{-2}$ and 516.22 $g.m^{-2}$ respectively. In addition that both of the 6row barley genotypes p5 and p6 could achieve the highest grain yield performance in both of Koya and Einkawa locations, the significant gain in grain yield was about 18.5% averaged from both locations and all seasons. (table 6)

4-3 Interaction between Seasons and Genotypes (L×G):

Higher achievement were obtained in plant height , flag leaf area Thousand grain weight , number of grains $spike^{-1}$ and harvest index from the interactions among season3 and the genotypes P6, P7, P1 , C1 and p1 respectively (Table 7) . None of the pedigrees in their interactions with season3 dominated the control (Acsad 12) in grain yield, season 1 is lower performance resulted in lower values of number of spikes m^{-2}, flag leaf area and thousand grain weight in its interaction with the genotypes P1, P2 , p5 and again P5 respectively , while the interaction between season 2 and Acsad 12 resulted in lower grain yield performance.

Table (4) : Effect of genotypes on some vegetative, yield and yield components of 10 studied genotypes of barley.

Genotypes / Characters	Six row barley					Two row barley					*Tuckey's MSD
	P1	P2	P3	P4	Acsad12 (C1)	P5	P6	P7	P8	Acsad14 (C2)	
Plant height cm (PH)	86.33 a-c	80.44 c	89.33 a	86.61 ab	82.78 bc	88.5 ab	91.61 a	87.17 ab	92.06 a	80.44 c	5.956
Flag leaf area cm^2 (FLA)	11.76 cd	10.68 d	12.72 b-d	13.05 b-d	10.94 cd	18.17 a	17.22 a-c	19.72 a	18.28 a	12.00 c-d	6.316
Leaf area index (LAI)	3.12 a	2.82 a	3.42 a	3.42 a	2.33 a	2.39 a	2.18 a	2.58 a	2.27 a	1.90 a	1.694 (ns)
Spike length (SL)	9.31 a	9.31 a	9.17 a	9.19 a	8.11 b	7.25 cd	7.06 cd	7.14 cd	7.67 bc	6.67 d	0.849
Thousand grain weight g (TGW)	40.25 ab	34.94 c	36.93 bc	36.42 bc	42.39 a	38.76 a-c	40.61 ab	37.74 a-c	40.41 ab	34.01 c	5.109
Grain number $spike^{-1}$ (GS)	16.83 b	14.78 b	15.00 b	16.22 b	15.00 b	28.06 a	27.28 a	27.17 a	27.56 a	25.94 a	3.647
Number of spikes m^{-2} (SM)	342.06 ab	356.56 a	337.72 ab	346.44 ab	310.17 bc	302.83 bc	283.06 c	267.56 cd	236.67 d	276.28 cd	45.412
Grain yield g m^{-2} (GY)	458.11 bc	469.17 bc	468.56 bc	425.83 c	414.61 c	610.39 a	572.67 ab	519.44 a-c	520.67 a-c	484.06 bc	124.22
Biological yield g m^{-2} (BY)	1210.2 d	1338.5 b-d	1394.2 a-d	1325.3 b-d	1288.1 cd	1569.4 a	1530.4 a	1465.9 a-c	1491.3 a-c	1497.5 a	208.69
Harvest Index (HI)	0.41	0.37	0.35	0.32	0.33	0.41	0.41	0.37	0.37	0.35	1.29 (ns)

***Means followed by the same letter aren't significantly differed.**

Table (5) : Effect of interaction between growing seasons and locations on some vegetative, yield and yield components of 10 studied genotypes of barley.

Seasons *Locations Characters	Season1 × Einkawa	Season 1 × Koya	Season2 × Einkawa	Season2 × Koya	Season3 × Einkawa	Season 3 × Koya	*Tuckey's MSD
Plant height cm (PH)	64.6 e	96.37 c	83.13 d	61.9 e	102.63 b	110.53 a	4.146
Flag leaf area cm^2 (FLA)	10.47 de	15.41 bc	19.27 ab	7.33 e	22.13 a	12.12 cd	4.397
Leaf area index (LAI)	2.7 a	2.21 a	2.73 a	2.95 a	2.67 a	2.6 a	1.178 (ns)
Spike length (SL)	7.7 b	7.7 b	9.57 a	7.13 b	9.00 a	7.42 b	0.591
Thousand grain weight g (TGW)	31.82 d	35.73 c	41.22 ab	39.47 ab	38.3 bc	42.93 a	3.556
Grain number $spike^{-1}$ (GS)	7.73 c	6.5 c	27.87 ab	27.03 b	29.2 ab	29.97 a	2.539
Number of spikes m^{-2} (SM)	268.57 d	208.77 e	305.07 c	417.43 a	262.1 d	373.67 b	31.61
Grain yield g m^{-2} (GY)	237.7 d	378.33 c	368.27 c	471.93 b	734.97 a	774.9 a	86.466
Biological yield g m^{-2} (BIOL)	1143.2 d	2158.7 a	1318 c	962.93 e	1322.7 c	1561 b	145.26
Harvest Index (HI)	0.21	0.18	0.27	0.5	0.55	0.5	ns

***Means followed by the same letter aren't significantly differed.**

Table (6) : Effect of interaction between Locations and Genotypes on some vegetative, yield and yield components of 10 studied genotypes of barley.

Location × Genotype		Plant Height cm	Flag leaf area cm^{-2}	Leaf Area Index	Spike Length cm	1000 Grain Weight g	Spike grain number	Spike number m^{-2}	Grain Yield gm^{-2}	Biological yield gm^{-2}	Harvest index
Einkawa (Einkawa)	P1	84.3 d-g	14.6 a-e	2.6 ab	9.8 a-c	36.5 b-d	17.1	334.3 b-e	365.1 f	961.1 g	0.35 b-d
	P2	75.3 g	13.6 a-e	2.6 ab	9.8 a-c	33.0 d	13.8 c	341.6 b-d	444.3 b-f	1192.3 e-g	0.35 b-d
	P3	84.4 dg	18.2 ab	4.3 a	10.0 ab	34.9 cd	14.9 c	298.9 c-f	420.9 d-f	1247.0 d-g	0.33 b-d
	P4	83.9 d-g	18.9 ab	4.4 a	10.2 a	34.12 d	16.9 c	283.3 d-f	370.7 f	1184.4 e-g	0.30 d
	C1	80.1 e-g	15.1 a-e	2.3 ab	8.6 cd	42.3 ab	14.8 c	245.6 fg	361.3 f	1119.2 e-g	0.31 cd
	P5	87.9 a-e	20.1 a	1.9 b	7.7 d-f	40.8 a-c	29.7 a	253.7 fg	526.9 a-f	1417.3 a-f	0.38 a-d
	P6	88.7 a-e	18.3 ab	2.3 ab	7.8 d-f	39.0 a-d	29.9 a	271.6 fg	592.1 a-c	1474.6 a-e	0.40 a-d
	P7	83.6 d-g	21.1 a	2.6 ab	7.8 d-f	38.6 a-d	26.56 ab	269.7 fg	500.1 c-f	1364 b-f	0.36 b-d
	P8	90.0 a-d	20.2 a	2.1 b	8.3 d	38.8 a-d	28.3 ab	216.2 g	435 c-f	1327.8 c-f	0.34 b-d
	P9	76.3 fg	12.8 a-e	1.7 b	7.7 d-f	32.9 d	24.1 b	271.0 fg	453.3 b-f	1325.2 c-f	0.34 b-d
	C2	88.3 a-e	8.97c-e	3.6 ab	8.8 b-d	44.0 a	16.6 c	349.8 fg	551.1 a-d	1459.2 a-e	0.47 a
Koya	P1	85.6 a-f	7.8 de	3.0 ab	8.8 bcd	36.9 b-d	15.8 c	371.6 ab	494.0 b-f	1484.7 a-e	0.38 a-d
	P2	94.2 ab	7.2 e	2.5 ab	8.3 d	38.9 a-d	15.1 c	376.6 ab	516.2 b-f	1541.3 a-d	0.37 a-d
	P3	89.3 a-e	7.2 e	2.5 ab	8.2 de	38.7 a-d	15.56 c	409.6 a	481.0 b-f	1466.2 a-e	0.35 a-c
	P4	85.4 a-f	6.8 e	2.3 ab	7.7 d-f	42.4 ab	15.2 c	374.8 ab	467.9 b-f	1456.9 a-e	0.35 a-c
	C1	89.1 a-e	16.2 ab	2.8 ab	6.8 f-h	36.7 b-d	26.4 ab	352.0 a-c	693.9 a	1721.6 a	0.43ab
	P5	94.6 a	16.1 a-d	2.1 b	6.3 gh	42.2 ab	24.7 ab	294.6 c-f	553.2 a-d	1586.2 a-c	0.41 a-c
	P6	90.8 a-d	18.3 ab	2.6 ab	6.5 f-h	36.9 b-d	27.8 ab	265.4 fg	538.8 a-d	1567.9 a-c	0.39 a-d
	P7	94.1 a-c	16.3 a-c	2.4 ab	7.0 f-h	42.0 ab	26.8 ab	257.1 fg	606.3 ab	1654.8 ab	0.40 a-c
	P8	84.6 b-g	11.2 b-e	2.1 b	5.7 h	35.1 cd	27.8 ab	281.6 ef	514.8 b-f	1669.8 ab	0.36 b-d
	P9	84.3 d-g	14.6 a-e	2.6 ab	9.9 a-c	36.5 b-d	17.1 c	334.3 b-e	365.1 f	961.1 g	0.35 b-d
	C2	75.3 g	13.6 a-e	2.6 ab	9.8 a-c	33.0 d	13.8 c	341.6 b-d	444.3 b-f	1192.3 e-g	0.35 b-d
*Tuckey's MSD		9.670	8.435	2.247	1.285	6.171	5.587	59.132	170.98	316.35	0.1114

Table (7) shows the effects of Interaction between Seasons and Genotypes on some vegetative, yield and yield components of 10 studied genotypes of barley.

Seasons × Genotypes		Plant Height cm	Flag leaf area cm^{-2}	Leaf Area Index	Spike Length cm	1000 Grain Weight g	Spike grain number	Spike number m^{-2}	Grain Yield $g.m^{-2}$	Biological yield gm^{-2}	Harvest index
Season 1	P1	78.3 d-h	8.5 cd	2.6 a-c	8.5 b-f	34.7 e-g	4.7 f	220.0 lm	200.5 j	1441.7 d-i	0.18 k
	P2	71.5 hi	6.8 d	1.9 bc	8.3 c-g	33.2 e-g	5.3 f	255.3 h-m	225.8 j	1425.8 d-i	0.18 k
	P3	86.0 c-e	9.5 b-d	3.1 a-c	9.2 a-d	36.0 d-f	6.67 f	238.8 j-m	265.3 ij	1605.0 a-f	0.17 k
	P4	86.7 cd	9.6 b-d	2.9 a-c	9.2 a-d	35.3 d-g	7.3 f	259.2 g-m	266.8 ij	1431.7 d-i	0.18 k
	C1	74.3 gh	8.5 cd	2.1 bc	7.5 f-h	37.0 d-f	5.5 f	227.3 k-m	190.5 j	1369.2 e-i	0.14 k
	P5	84.8 d-f	16.8 a-d	2.3 bc	7.2 f-h	34.9 e-g	7.0 f	243.7 i-m	396.3 g-j	1831.7 a-c	0.22 jk
	P6	84.5d-g	19.0 a-c	2.3 bc	7.0 f-h	35.2 e-g	7.5 f	208.2 m	389.3 h-j	1870.8 a-c	0.22 jk
	P7	77.7 d-h	19.3 a-c	2.4 bc	6.7 gh	28.4 g	11.8 ef	227.0 k-m	336.5 h-j	1689.2 a-e	0.21 jk
	P8	86.0 c-e	19 a-c	2.9 a-c	7.3 f-h	35.1 e-g	9.0 f	239.0 j-m	480.2 e-i	1917.5 ab	0.25 h-k
	P9	75.0 d-h	12.3 a-d	2.1 bc	6.2 h	28.2 g	6.3 f	268.2 f-m	328.8 h-j	1926.7 a	0.18 k
Season 2	P1	80.0 d-h	12.8 a-d	3.4 a-c	10.3 a	37.4 d-f	23.3 d	471.5 a	342.7 h-j	835.83 j	0.43 c-g
	P2	68.2 ih	12.2 a-d	3.2 a-c	10.2 ab	31.5 fg	20.8 d	477.3 a	391.2 h-j	1142.2 g-j	0.37 f-i
	P3	78.7 d-h	8.5 cd	1.8 bc	9.7 a-c	34.0 e-g	19.7 d	416.8 a-c	412.2 g-j	1124.7 h-j	0.38 e-h
	P4	75.8 d-h	10.0 b-d	2.1 bc	9.3 a-c	36.8 d-f	19.5 d	445.3 ab	368.0 h-j	1121.2 h-j	0.34 gh
	C1	76.2 dh	11.8 a-d	2.0 bc	8.7 a-f	43.2 a-d	20.0 d	389.0 b-d	361.0 h-j	1149.3 g-j	0.32 gh
	P5	72.3 h-j	16.12 a-d	3.4 a-c	7.2 f-h	46.3 a-c	36.2 a-c	296.7 f-l	524.7 d-h	1382.3 e-i	0.39 e-h
	P6	72.5 hi	16.0 a-d	3.2 a-c	6.7 gh	45.5 a-c	33.5 bc	319.8 d-i	478.3 e-i	1168.7 g-j	0.45 c-g
	P7	68.2 ij	18.2 a-c	4.1ab	7.3 f-h	46.3 a-c	33.3 bc	277.2 f-l	460.7 f-i	1231.2 i-g	0.4 d-g
	P8	73.5 g-i	16.2 a-d	2.7 a-c	7.5 d-h	45.5 a-c	37.0 a-c	214.2 m	465.2 f-i	1190.5 g-j	0.42 c-g
	P9	59.8 j	11.2 a-d	2.5 a-c	6.7 gh	36.8 d-f	31.2 c	304.7 e-j	397.2 g-j	1058.8 ij	0.39 e-h
Season 3	P1	100.7 b	13.9 a-d	3.4 a-c	9.1 a-e	48.7 a	22.5 d	334.7 d-g	831.2 a-c	1353 e-i	0.62 a
	P2	101.7 b	13.1 a-d	3.3 a-c	9.4 a-c	40.2 b-e	18.2 de	337 d-f	790.5 a-c	1447.5 d-i	0.55 abc
	P3	103.3 b	20.2 ab	5.4 a	8.7 a-f	40.8 a-e	18.7 de	357.5 c-e	728.2 a-d	1452.8 d-i	0.51 a-f
	P4	97.3 bc	19.6 ab	5.3 a	9.1 a-e	37.2 d-f	21.8 d	334.8 d-g	642.7 d-f	1423.2 e-i	0.46 c-f
	C1	97.8 bc	12.5 a-d	2.9 a-c	8.2 c-g	47.0 ab	19.5 d	314.2 d-i	692.3 a-e	1345.7 e-i	0.52 a-e
	P5	108.3ab	21.5 a	1.4 bc	7.4 e-h	35.0 e-g	41.0 a	368.2 c-e	910.2 a	1494.3 c-h	0.61 ab
	P6	117.8 a	16.7 a-d	1.0 c	7.5 d-h	41.2 a-e	40.8 a	321.2 d-h	850.3 ab	1551.7 c-f	0.55 a-c
	P7	115.7 a	21.7 a	1.3 bc	7.4 e-h	38.5 c-f	36.3 a-c	298.5 e-i	761.2 a-c	1477.5 d-i	0.52 a-e
	P8	116.7 a	19.7 ab	1.2 bc	8.2 c-g	40.7 a-e	36.7 a-c	256.8 h-i	616.7 c-g	1365.8 e-i	0.45 c-g
	C2	106.5 ab	12.5 a-d	1.0 c	7.2 f-h	37.0 d-f	40.3 ab	256 h-i	726.2 a-d	1507.0 c-g	0.48 b-g

4-4 The Triple Interaction; Seasons, Locations and Genotypes (Y×L×G):

Table (8) postulates that the significant highest values of SL,TGW , BYand HI were obtained from the interaction between season 1 , koya location and each of the genotypes P1, P7, P1 , P4 and P6 respectively , while the interaction between season 3, einkawa and genotypes P6 and P7 produced the tallest plants and grain yield respectively , while the dominated values of BY, GY and TGW were produced from the interaction among season 2 , and the pedigree P1 and the control cultivar Acsad 14.

Table (8): The effect of the season, site and genotype triple interaction on some of vegetative , yield and yield component characters .

Interaction			Plant Height cm	Flag leaf area cm^{-2}	Leaf Area Index	Spike Length cm	1000 Grain Weigh t g	Spike grain number	Spike number m^{-2}	Grain Yield $g.m^{-2}$	Biological yield $g.m^{-2}$	Harvest index
season	Location	Genotype										
Season 1	Einkawa	P1	62.7	8.7	2.3	8.0	33.0	4.7	300.7	209.7	766.7	0.27
		P2	54.0	8.0	2.0	8.3	32.0	5.7	296.0	177.3	793.3	0.22
		P3	72.0	11.7	3.8	9.7	35.3	7.3	285.7	190.0	1180.0	0.16
		P4	70.3	11.3	3.2	9.3	34.8	7.3	259.0	130.3	980.0	0.13
		C1	56.0	11.7	2.4	7.0	34.0	4.7	263.0	137.0	896.7	0.15
		P5	71.7	8.7	2.2	7.0	34.2	9.0	257.3	344.7	1411.7	0.24
		P6	68.3	11.3	2.8	7.3	32.6	10.7	238.7	296.3	1343.3	0.23
		P7	59.3	12.0	2.7	6.3	25.4	12.7	252.7	256.3	1195.0	0.21
		P8	71.7	13.0	3.4	7.3	30.8	9.0	247.7	349.3	1423.3	0.24
	Koya	C2	60.0	8.3	2.2	6.7	26.0	6.3	285.0	286.0	1441.7	0.20
		P1	94.0	8.4	2.8	9.0	36.3	4.7	139.3	191.3	2116.7	0.09
		P2	89.0	5.6	1.9	8.3	34.3	5.0	214.7	274.3	2058.3	0.13
		P3	100.0	7.3	2.4	8.7	36.7	6.0	192.0	340.7	2030.0	0.17
		P4	103.0	7.8	2.6	9.0	35.7	7.3	259.3	403.3	1883.3	0.22
		C1	92.7	5.3	1.8	8.0	40.0	6.3	191.7	244.0	1841.7	0.13
		P5	98.0	25.0	2.4	7.3	35.7	5.0	230.0	448.0	2251.7	0.20
		P6	100.7	26.7	1.8	6.7	37.7	4.3	177.7	482.3	2398.3	0.20
		P7	96.0	26.7	2.0	7.0	31.3	11.0	201.3	416.7	2183.3	0.20
		P8	100.3	25.0	2.4	7.3	39.3	9.0	230.3	611.0	2411.7	0.25
		C2	90.0	16.3	2.0	5.7	30.3	6.3	251.3	371.7	2411.7	0.16
Season 2	Einkawa	P1	91.7	16.0	2.3	12.0	34.2	23.0	418.0	142.7	870.0	0.17
		P2	79.0	15.3	2.3	11.0	30.3	20.3	459.7	343.3	1373.3	0.25
		P3	85.0	11.0	1.0	11.3	32.7	22.0	317.7	332.7	1196.7	0.28
		P4	85.3	14.3	1.8	11.3	32.7	21.7	328.0	305.3	1193.3	0.26
		C1	86.7	16.3	1.2	10.0	40.0	21.7	247.0	204.3	1226.7	0.16
		P5	84.7	25.0	3.6	8.0	48.7	37.0	232.3	502.0	1573.3	0.32
		P6	84.3	26.7	4.1	7.3	47.7	36.7	273.7	509.3	1563.3	0.33
		P7	79.7	26.7	5.1	8.7	55.0	33.0	284.3	491.0	1510.0	0.33
		P8	85.7	25.0	2.9	8.3	48.7	37.3	180.7	479.3	1483.3	0.33
		C2	69.3	16.3	3.0	7.7	42.3	26.0	309.3	372.7	1190.0	0.31
Season 2	Koya	P1	68.3	9.7	4.4	8.7	40.7	23.7	525.0	542.7	801.7	0.69
		P2	57.3	9.0	4.1	9.3	32.7	21.3	495.0	439.0	911.0	0.49
		P3	72.3	6.0	2.5	8.0	35.3	17.3	516.0	491.7	1052.7	0.48
		P4	66.3	5.7	2.3	7.3	41.0	17.3	562.7	430.7	1049.0	0.41
		C1	65.7	7.3	2.8	7.3	46.3	18.3	531.0	517.7	1072.0	0.48
		P5	60.0	7.3	3.3	6.3	44.0	35.3	361.0	547.3	1191.3	0.46
		P6	60.7	5.3	2.3	6.0	43.3	30.3	366.0	447.3	774.0	0.58
		P7	56.7	9.7	3.1	6.0	37.7	33.7	270.0	430.3	952.3	0.47
		P8	61.3	7.3	2.4	6.7	42.3	36.7	247.7	451.0	897.7	0.50
		C2	50.3	6.0	2.1	5.7	31.3	36.3	300.0	421.7	927.7	0.47
Season 3	Einkawa	P1	98.7	19.0	3.2	9.3	42.3	23.7	284.3	743.0	1246.7	0.60
		P2	93.0	17.3	3.6	10.0	36.7	15.3	269.0	812.3	1410.3	0.58
		P3	96.3	32.0	8.3	9.0	37.0	15.3	293.3	740.0	1364.3	0.55
		P4	96.0	31.0	8.2	10.0	35.0	21.7	263.0	676.3	1380.0	0.49
		C1	97.7	17.3	3.4	8.7	53.0	18.0	226.7	742.7	1234.3	0.60
		P5	107.3	26.7	0.8	8.0	39.7	43.0	271.3	734.0	1267.0	0.58
		P6	113.3	17.0	0.7	8.7	36.7	42.3	302.3	970.7	1517.0	0.64
		P7	111.7	24.7	0.9	8.3	35.3	34.0	272.0	753.0	1387.0	0.54
		P8	112.7	22.7	0.8	9.3	37.0	38.7	220.3	476.3	1076.7	0.44
		C2	99.7	13.7	0.7	8.7	30.3	40.0	218.7	701.3	1344.0	0.51
	Koya	P1	102.7	8.8	3.7	8.8	55.0	21.3	385.0	919.3	1459.3	0.64
		P2	110.3	8.8	3.0	8.8	43.7	21.0	405.0	768.7	1484.7	0.52
		P3	110.3	8.3	2.5	8.3	44.7	22.0	421.7	716.3	1541.3	0.47
		P4	98.7	8.2	2.5	8.2	39.3	22.0	406.7	609.0	1466.3	0.42
		C1	98.0	7.7	2.3	7.7	41.0	21.0	401.7	642.0	1457.0	0.44
		P5	109.3	16.3	2.9	6.8	30.3	39.0	465.0	1086.3	1721.7	0.63
		P6	122.3	16.3	2.1	6.3	45.7	39.3	340.0	730.0	1586.3	0.46
		P7	119.7	18.7	2.6	6.5	41.7	38.7	325.0	769.3	1568.0	0.50
		P8	120.7	16.7	2.5	7.0	44.3	34.7	293.3	757.0	1655.0	0.46
		C2	113.3	11.3	2.1	5.7	43.7	40.7	293.3	751.0	1670.0	0.45

Usually letters are not written in Tuckey's analysis, so I got enough with Tukey's Studentized Range (HSD).due to the wide area of the table.

Conclusions and recommendations

about barley genotypic choices in this study:These results highlight the ability of some barley genotypes to keep yield potential across years and locations. Importantly, the results also illustrated the yield benefit obtained from sowing genotypes in the rainy areas of the semiarid region. Our plant breeders and agronomists are asked to concentrate on such beneficial researches , but with strong support from the government , especially during the next package of water scarcity that seems to be arose.

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