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EVALUATION OF DROUGHT TOLERANCE FOR SOME GENOTYPES OF BARLEY CROP

Abdulsattar A.j.Al-Rijabo Salih M.I. Aljoboury Mohammed Ameen Haji
Mosul Univ. Agric. College Field crop Dept.

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Correspondence:
Abdulsattar A.j.Al-Rijabo

Mosul Univ. Agric. College Field crop Dept.

ABSTRACT:

The experiment was conducted at season 2010 in the research roof shade of Field Crop Department Agriculture and Forestry College Mosul University in13 liters capacity plastic pots, the research plan include study the effect of two factors: first cultivars with four levels including four barley cultivars : Raihan a six rows cv. (Cv.1) old Iraqi entrance cultivar and three new entered cultivars , BOI 182 a six rows cv. (Cv.2), BA2391 a six rows cv.(Cv.3) and Otis a two row cv.(Cv.4).The second factor was Irrigation with three levels chosen depending on 2007 season average for precipitation and distribution in Low Rainfall Area which equal (10.8 L/pot), Moderate Rainfall Area which equal (14.2L/pot) and High Rainfall Area which equal (24.5L/pot) . To study the effect of each factor and its interaction on growth , yield and its component in barley, five grains were seeded in 13 liter volume pots in a circle mediates pot diameter (18 cm) with seeding depth (3 cm), 30 mm of water was added to all pots after sowing as germination dose, the impact of interaction effect of the two factors in growth , yield and its components of barley crop were studied.

The results showed that Otis cv. was superior in plant height followed by BA2391cv.. BA2391cv. also was the highest in a number of tillers , spikes / pot , grain yield , straw weight and biological weight . while all cultivars were equal in No. of grain / spike. This results caused to recommend continuing studies with cv. BA2391 because most traits values of this cv. surpassed domestic cv. Raihan . The irrigation factor has significant effect to increase all values of all the traits with increased amounts of irrigation and the highest value realized at the third level of irrigation and less value at the first level.

تقويم تحمل الجفاف لتراكيب وراثية من محصول الشعير

عبد الستار اسمير جاسم الرجبو صالح محمد ابراهيم الجبوري محمد أمين حاجي
جامعة الموصل– كلية الزراعة والغابات– قسم المحاصيل الحقلية

الخلاصة

اجريت التجربة في المسقف البحثي لقسم المحاصيل الحقلية كلية الزراعة والغابات جامعة الموصل في أصص بلاستيكية سعة 13 لتر , وتضمنت خطة البحث دراسة تأثير عاملين الأول الصنف وبأربعة مستويات تمثل أربعة أصناف من الشعير وهي (ريحان – وهو صنف سداسي الصفوف مدخل قديما إلى العراق وثلاثة أصناف مدخلة حديثا وهي BOI 182 وهو صنف سداسي الصفوف والصنف BA2391 وهو سداسي أيضا , والصنف Otis وهو صنف ثنائي الصفوف) والعامل الثاني وهو الري ويمثل معدلا تقريبيا لتوزيع الهطول للمواقع محدودة الأمطار(10,8 لتر/أصيص) وشبه مضمونة الأمطار(14,2 لتر/أصيص) ومضمونة الأمطار(24,5 لتر/أصيص). ودُرس تأثير العاملين السابقين مع تأثير تداخلاتهما الثنائية في صفات النمو والحاصل ومكوناته لمحصول الشعير.

أوضحت النتائج تفوق الصنف Otis في صفة ارتفاع النبات تلاه في ذلك الصنف BA2391 , وحقق الصنف BA2391 أيضا أعلى قيمة في عدد الأشطاء الكلي/أصيص وعدد السنابل /أصيص وحاصل الحبوب(غم) ووزن القش والحاصل البيولوجي فيما تساوت جميع الأصناف في صفة عدد الحبوب في السنبلة , إن هذه النتيجة تجعلنا نوصي باستمرار الدراسات مع الصنف BA2391 كون أغلب قيم صفاته أعلى من الصنف المحلي ريحان . في حين سجل عامل الري تأثيرا معنويا واضحا إذ توافقت قيم جميع الصفات مع زيادة كميات الري وكانت أعلى قيمة متحققة عند المستوى الثالث للري واقل قيمة عند المستوى الأول .

الكلمات الدالة :
تقويم ، شعير

للمراسلة :
عبد الستار اسمير جاسم الرجبو
جامعة الموصل– كلية الزراعة والغابات– قسم المحاصيل الحقلية

INTRODUCTION:

Rain-fed agriculture suffer in most countries from the risk of drought or erratic distribution of rainfall during the growing season, and suffer cultivated plants under such condition suffer from water stress effect which involved various phenomena, including cells wilting cells and fully metabolic confusing (Khalaf and Alrijabo 2006).

Emine et al (2007) tested ten varieties of barley under conditions of water stress . The researcher indicated that the distinctive trait in drought tolerance is the final outcome of grain yield .

To evaluate reactions of barley genotypes to drought stress during seed germination, seedling and adult plant stages, Wayss et al (2010) studied twenty genotypes and two cultivar were studied in controlled conditions and field experiment under normal irrigation and water stress conditions. The results showed that with decrease of water potential all characteristics of germination were significantly decreased. In field experiment, drought stress reduced early growth rate, relative water content and relative water loss. Positive and significant correlation was found between stress tolerance index (STI) and grain yield in both normal irrigation and stress conditions. Based on higher correlation between STI and grain yield in both normal and drought conditions, this index was found to be the best index for selecting drought resistant genotypes.

The researchers Águeda and Luís (2011) tested the ability of some cultivars of barley on drought tolerance through an experience in Petri dishes by using polyethylene glycol 6000 as a substitute of water stress , the results showed that the cultivars differed among themselves in coleoptile length. The cultivars with high coleoptile length was more drought resistance comparing with short coleoptile cultivars ,this trait achieved an early detection of the varieties of high drought resistance specially after sowing these cultivars in field and the result of tall coleoptile resulted the highest grain yield under water stress condition. This results indicated too that tall coleoptile then tall stem help in drought tolerance of crops.

Giancarla et al (2012) Indicated that some drought tolerance evaluation research depend on indirect method of testing like: excised leaf water loss (ELWL), relative water content (RWC).The aim of the present study was to evaluate the drought tolerance of 19 Romanian and foreign barley cultivars using indirect methods of testing after osmotic stress using polyethylene glycol 30% and 50% PEG6000 solutions. These test methods are based on the determination of some characteristics closely correlated with plant response to hydric stress conditions.

Mahdi (2012) determined drought tolerant genotypes with high yield in stress and non-stress conditions. Ten barley genotypes were tested in a randomized complete block design with three replications during 2010-2011 growing season. Eight drought tolerant indices mean productivity (MP), stress tolerance index (STI), tolerance index (TOL), and yield index (YI) were estimated for each genotype based on yield under stress (Ys) and non-stress (Yp) conditions. There were significant differences for all criteria among the genotypes. The correlation coefficients indicated that mean productivity (MP) (grain yield diagrams and cluster analysis) and stress tolerance index (STI) were the best criteria for selection of high yielding genotypes under stress and non-stress conditions. Principal components analysis showed two components which explained 99.66% variation. Based on the results of principal component analysis, cumulative grain yield diagrams and cluster analysis, Nosrat cultivar was the most tolerant genotype and showed considerable potential to improve drought tolerance in barley breeding programs.

MATERIALS AND METHODS:

This experiment was implemented in roof shade house of field crop department at season 2009-2010 includes two factors, and these factors are: - 1- cultivars with four levels including four barley cultivars : Raihan a six rows cv. (Cv.1) old Iraqi entrance cultivar and three new entered cultivars , BOI 182 a six rows cv. (Cv.2), BA2391 a six rows cv.(Cv.3) and Otis a two row cv.(Cv.4). 2- Irrigation with three levels chosen depending on 2007 season average for precipitation and distribution in Low Rainfall Area which equal (10.8 L/pot), Moderate Rainfall Area which equal (14.2L/pot) and High Rainfall Area which equal (24.5L/pot)(Alrijabo et al ,2007) . To study the effect of each factor and its interaction on growth , yield and its component in barley, five grains were seeded in 13 liter volume pots in a circle mediates pot diameter (18 cm) with seeding depth (3 cm), 30 mm of water was added to all pots after sowing as germination dose. after germination just three plants per pot were kept . The design of this experiment is a factorial experiment in completely randomized design (CRD) with two factors in three replicates . The results was analyzed by using the SAS program. Duncan test was used to determine the significant between treatments at a level (0,05). Soil analysis made by taking samples from the used soil before planting for physical and chemical analyses , the results were as shown in Table (1), no fertilizer was added to ensure the prevent of additional fertilizer osmotic stress under the LRA and MRA irrigation levels and to ensure independent evaluation between the cultivars . Traits that were studied : - plant height (cm) - the

total amount of tillers / pot - the total amount of spikes / pot - number of grains / pot - the number of grains / spike. – grain yield (gm / pot) - straw weight (gm / pot) - biological yield (gm / pot).

Table (1) physical and chemical characteristics of the soil

التقدير					
	Saturated Soil Past	ppm	Meq/L	%Clay	40.6
Soluble Ca		128.0	6.4	%Loam	34.66
Soluble Mg		96.8	8.0	%Sand	24.74
Soluble Chloride		15.97	0.45	النسجة	Sandy Loam
Soluble Bicarbonate		122.0	2.0	N%	0.48
Soluble Na		-	0.425	(Ds./m) EC	1.304
Soluble SO4		1689	35.2	PH	6.7
Phosphate	Available	74.0	1.20		
K		0.34	15.0		

Table(2) Irrigation dose according to the precipitation and distribution of LRA.

Dates	Liter/pot	Dates	Liter/pot
2006/12/28	1.36	2007/2/27	0.16
2007/1/6	0.56	2007/3/5	0.32
2007/1/7	0.48	2007/3/15	0.08
2007/1/8	0.32	2007/3/18	0.32
2007/2/4	1.84	2007/3/20	0.08
2007/2/5	0.24	2007/3/24	0.24
2007/2/6	0.24	2007/4/1	0.16
2007/2/8	0.96	2007/4/3	0.24
2007/2/12	0.24	2007/4/7	0.32
2007/2/15	0.72	2007/4/15	0.75
2007/2/16	0.48	2007/5/6	0.72
		Total L./pot	**10.8**

Table(3) Irrigation dose according to the precipitation and distribution of MRA

Dates	Liter/pot	Dates	Liter/pot
2006/12/29	1.20	2007/3/20	0.16
2007/1/7	1.52	2007/3/24	0.4
2007/1/9	0.75	2007/4/1	0.32
2007/1/14	0.24	2007/4/3	0.96
2007/1/29	0.32	2007/4/9	0.24
2007/1/31	0.24	2007/4/10	0.16
2007/2/4	3.600	2007/4/12	0.48
2007/2/5	0.16	2007/4/15	0.48
2007/2/6	0.32	2007/4/16	0.08
20007/2/18	0.72	2007/4/2	0.16
2007/2/27	0.16	2007/4/29	0.32
2007/3/5	0.08	2007/5/5	0.48
2007/3/17	0.64	**Total L./pot**	**14.2**

.Table(4) Irrigation dose according to the precipitation and distribution of HRA

Dates	Liter/pot	Dates	Liter/pot
2006/12/27	1.68	2007/3/17	0.16
2006/12/29	3.52	2007/3/18	0.12
2007/1/5	0.64	2007/3/20	0.36
2007/1/7	2.00	2007/3/24	0.20
2007/1/29	0.48	2007/4/2	0.44
2007/1/31	0.84	2007/4/3	0.4
2007/2/4	2.16	2007/4/7	0.32
2007/2/5	0.64	2007/4/12	0.4
2007/2/6	0.72	2007/4/15	0.8
2007/2/7	0.96	2007/4/16	0.72
2007/2/8	0.32	2007/4/19	0.20
2007/2/16	1.6	2007/4/29	0.32
2007/2/18	1.04	2007/5/13	0.12
2007/2/26	0.08	2007/5/14	1.04
2007/2/26	0.08	2007/5/16	0.44
2007/3/6	0.92	**Total L./pot**	**24.5**
2007/3/14	0.36		
2007/3/16	0.4		

RESULTS AND DISCUSSION:

The effect of Irrigation and cultivars in plant height (cm):

The results in Table (5) indicated that the third level of irrigation(49.00 cm) and barley cv.4 (48.00 cm) was superior in plant height comparing with other levels of irrigation and cultivars , the interaction between cultivars and irrigation levels indicated that the cv.4 x Ir.2 and cv.4 x Ir.3 have the highest significant interaction value in plant height(59.667 cm , 52.333 cm) respectively comparing with other interactions.

Table (5) The effect of Irrigation and cultivars in plant height (cm)

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	28.000 ef	36.000 de	49.000 bc	37.667 b
Cv.2	24.667 f	41.333 cd	45.000 bc	37.000 b
Cv.3	35.333 de	35.610 de	49.667 bc	40.203 b
Cv.4	32.000 ef	59.667 a	52.333 ab	48.000 a
Irrigation Mean	30.000 c	43.153 b	49.000 a	

The effect of Irrigation and cultivars in No. tillers / pot and No. of spikes /pot:

In Table(6) and Table (7) it seem that just cv.4 have the lowest value in barley cultivars levels (2.667 tillers , 2.6667 spikes) and Ir.1 was the lowest too in Irrigation levels (2.917 tiller , 2.9167 spikes) , so the interaction between cv.4 x Ir.1 was the lowest (2.000 tillers , 2.000 spikes) comparing with all interactions value of these two traits. while the highest value of tillers was (4.778) in cv.3 and (4.417) in Ir.3 , and the highest value in spikes was (4.7778) in cv.3 and (4.4167) in Ir.3.

Table (6) The effect of Irrigation and cultivars in No. tillers/pot.

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	2.333 ab	4.667 a	4.333 ab	3.778 ab
Cv.2	3.000 ab	3.333 ab	5.000 a	3.778 ab
Cv.3	4.333 ab	5.000 a	5.000 a	4.778 a
Cv.4	2.000 b	2.667 ab	3.333 ab	2.667 b
Irrigation Mean	2.917 b	3.917 ab	4.417 a	

Table (7) The effect of Irrigation and cultivars in No. spikes/pot.

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	2.333 ab	4.667 a	4.333 ab	3.7778 ab
Cv.2	3.000 ab	3.333 ab	5.000 a	3.7778 ab
Cv.3	4.333 ab	5.000 a	5.000 a	4.7778 a
Cv.4	2.000 b	2.667 ab	3.333 ab	2.6667 b
Irrigation Mean	2.9167 b	3.9167 ab	4.4167 a	

The effect of Irrigation and cultivars in No. grains / spike :

There was no significant differences between all barley cultivars levels in No. of grains /spike , but in irrigation levels Ir.3 level was only superior in this trait (20.38) comparing with the other levels of Irrigation, in interaction result all Ir.2 and Ir.3 interactions with all levels of barley cultivars was significantly superior in No. grains /spike comparing with the interactions between all barley cultivars with Ir.1 level.The highest interaction value was in cv.1 x Ir.3 (20.953) comparing with the lowest value (1.000) in cv.4 x Ir.1 interaction.

Table (8) The effect of Irrigation and cultivars in No. grains/spike.

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	7.110 cd	13.517 abc	20.953 a	13.860 a
Cv.2	9.333 bcd	14.600 abc	20.557 a	14.830 a

Cv.3	7.533 cd	14.253 abc	19.670 ab	13.819 a
Cv.4	1.000 d	10.650 abcd	20.333 a	10.661 a
Irrigation Mean	6.24 c	13.26 b	20.38 a	

The effect of Irrigation and cultivars in grains yield (gm/pot) :

Third level of irrigation was registered positive significant effect in grains yield (2.260 gm/pot) while the only lowest significant value was in cv.4 (0.8211) comparing with other barley cultivars, the interaction of all barley cv.s with Ir.3 and the interaction of cv.3 x Ir.2 was superior in grain yield comparing with other interactions. The highest interaction value (2.6833) was in cv.1 x Ir.3 , while the lowest interaction value was in 0.0533) in cv.4 x Ir.1 .

Table (9) The effect of Irrigation and cultivars in grains yield (gm/pot).

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	0.3067 ef	1.6000 bcd	2.3600 ab	1.4222 a
Cv.2	0.2967 ef	1.3133 bcde	2.2433 ab	1.2844 ab
Cv.3	0.7500 cdef	1.9167 ab	2.6833 a	1.7833 a
Cv.4	0.0533 f	0.6567 def	1.7533 abc	0.8211 b
Irrigation Mean	0.352 c	1.372 b	2.260 a	

The effect of Irrigation and cultivars in straw weight and biological weight (gm/pot) :

In straw's weight (gm/pot) and biological yield (gm/pot) traits, the barley cultivars cv.3 and cv.1 have the highest significant value in straw weight (5.328 , 5.022).and biological yield (701111 , 6.4444) respectively comparing with other barley cultivars , Ir.3 (6.057) was superior in straw weight fallowed by Ir.2 (4.545) then Ir.1(2.973) respectively, Ir.3 (8.317) was superior too in biological yield fallowed by Ir.2 (5.917) then Ir.1(3.325) respectively , the highest interaction value in straw weight (7.517) and biological yield (10.200) was in Ir.3 with cv.3 without any significant differences with the interactions values of Ir.3 x cv.1 and Ir.3 x cv.2.

Table (10) The effect of Irrigation and cultivars in straw weight (gm/pot).

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	3.56 def	4.933 bcd	6.573 ab	5.022 a
Cv.2	2.836 ef	3.087 def	5.624 abc	3.849 b
Cv.3	3.15 def	5.316 bc	7.517 a	5.328 a
Cv.4	2.347 f	4.843 bcd	4.514 bcd	3.901 b
Irrigation Mean	2.973 c	4.545 b	6.057 a	

Table (11) The effect of Irrigation and cultivars in biological weight (gm/pot).

Irrigation / Cultivar	Ir.1	Ir.2	Ir.3	Cultivars Mean
Cv.1	3.867 def	6.533 bcd	8.933 ab	6.4444 ab
Cv.2	3.133 ef	4.400 def	7.867 abc	5.1333 bc
Cv.3	3.900 def	7.233 bc	10.200 a	7.1111 a
Cv.4	2.400 f	5.500 cde	6.267 bcd	4.7222 c
Irrigation Mean	3.325 c	5.917 b	8.317 a	

To discuss the results of this study , despite that this study depend on three rain fall areas which were Low rainfall Area , Moderate Rainfall Area and High Rainfall Area but our desire to evaluate the barley cultivars under severe drought tolerance evaluation without any additional osmotic stress interaction (No fertilizer used) we choose very drought season to use its daily rain precipitation in three different rainfall locations in Ninevah province as irrigation levels in the study.

The chosen season did not achieve acceptable yield in MRA and HRA locations in the province of Nineveh, and did not achieved any yield harvested on LRA location, so it was a clear effect of water stress in plants in this study, and certainly the highest values of studied traits were within the level of HRA and its interactions with all barley cultivars levels, for that the yield components results affected severely in this study under severe drought condition.

By reviewing the results of yield and its components traits in the varieties, most past studies have indicated that the high value of plant height trait gives significance indicator for drought tolerant and increased yield, but this has not been achieved with a variety of barley cv.4 because it was a two-rows not six rows like other tested varieties, though the barley cv.3 (BA2391) , which achieved the highest grain and straw yield was the highest in plant height compared with others six rows cultivars (cv.1 and cv.2) this results indicate what the previous researchers indicated that plant height trait is very important in determining the drought tolerance ability of any cultivar because tall stem under drought will help in supplying grain at grain filling stage with adequate nutrition food to complete its life cycle (Desalegn et al, 2001).In the same time and according to the results of this research it is clear that the grain yield is the most important trait to evaluate the drought tolerance in crops.

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