EVALUATION OF OAT VARIETIES UNDER SUFFICIENT AND INSUFFICIENT IRRIGATION

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ABSTRACT

This study was aimed to investigate the genetic variations of Oat cultivars under in sufficient of irrigation. A field experiment was carried out at the fields of with College of Agricultural Engineering Sciences ;University of Baghdad - Al-Jadriya during 2020-2021 seasons. The experiment was carried out using a Completely Block designwithin split-plot arrangement using three replicates under two treatments (verities and irrigation intervals). The main plots were irrigation intervals with moisture(50%, 25%, and 10%), while sub-plots were the varieties (Genzania, Anatolia, Plmula, Algoda, and Al-Shifa).The results showed that the third irrigation level had 75% flowering at highest averages93.67 days , and the V4 variety had the lowest average to weight of 250 grains about (7.67 g).While there was a significant differencesamong irrigation interval 75% flowering compared with other traits (22.8) ,(24.6)and (7.75) respectively. While the Alogodaproduced the highest yield (7.49 ton .h^{-1}) compared with the lowest Plmula gave (5.83 ton h^{-1})There are differences among of varieties under irrigation intervals.Thehighest genotypic coefficient toyield (94.7%) and the highest value of heritability was (98.75%).to the flowering.

Key words : varieties , oat, genetic variation , irrigation intervals, climate change, drought, wise resources consumption

دراسة التباينات الوراثية لاصناف من الشوفان تحت قلة وكفاية الري

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المستخلص

نفذه تجربة حقلية في الحقول التابعة لكلية علوم الهندسة الزراعية /جامعة بغداد–الجادرية خلال الموسم 2020–2021 بهدف دراسة التباينات الوراثية لاصناف من الشوفان تحت قلة الري .تم إجراء التجربة باستخدام تصميم القطاعات العشوائية الكاملة مع تحت تاثير معاملتين (أصناف وفترات ري). كانت الألواح الرئيسية هي فواصل الإرواء (50 ٪ ، 25 ٪ ، و 10 ٪) ،إماالألواح الثانوية شملت الأصناف المدخلة (Genzania, Anatolia, Plmula, Algoda, and Al-Shifa). أظهرت النتائج أن مستوى الري الثالث أعطى 75٪ من الإزهار أعلى معدلات (93.67 يوما) .وأعطى الصنف V4أقل متوسط لوزن 250 حبة حوالي (7.67 غم). في حين أن Alogoda أعطت أعلى عائد (7.49 طن .h−1) مقارنة مع أقل Plmula أعطى (5.83 طن .هـ$^{-1}$). هناك اختلافات بين الأصناف تحت فترات الريكما بلغت أعلى نسبة توريث بالمعنى الواسع (94.7٪) وأعلى قيمة لنسبة التوريث بالمعنى الواسع (98.75٪). نستنتج من ذلك يمكن استعمال الصنف Algoda في الزراعة للبيئة العراقية لارتفاع حاصله

الكلمات المفتاحية: الشوفان ، فترات الري ،أصناف ، التغايرات الوراثية، التغير المناخي،الجفاف، الاستخدام المسؤول للمصادر

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INTRODUCTION

Oat (*Avena sativa* L) one of the cereal crops relatedto poaceae and haseconomic importance for human and animal feed. It contains protein (12.2%), carbohydrates ,(57.8%), fiber (12.1%), and several amino acids (26). The cultivated area with oats in the world is 10 million hectares and a productivity of 25 million tons, but at Iraq the cultivated area was estimated at approximately 144 hectares with an average production of 415 tons (10). Among the significant reasons is water lacking in Iraq (34, 35, 36) as a result Knowledge aboutwater stress of oat is very important for crop management and production at the irrigated or dry lands (17). water stress has an effect on the growth of plants, reduce the development of apicalmeristem,water ions transferring, close stomata and photosynthesis assimilation rate (32). Thenet assimilation rate due to the decreases photosynthesis apparatus and this leads to disruption in flowers, fertilization and total of kernels (22). However; Water stress leads to reduce (ATP),mRNA gene expression and growth rate (1,3,5,30).The plant endure the serve stress via starting several important events in cells such as inducible gene expression (dehydration genes) to drought tolerant , to the production of anti-oxidant enzymes (Catalase , peroxidase , superoxide dismutase (12). Plant endures water stress not only via minimizing of loss water, but also, by enhances capacity of water uptake, decreases osmotic potential (8,14,45). Plant breeding methods as well as genotypes improving depend on the tolerance to biotic and abiotic stresses. The selection of progenies that have successful improved of the yield in dry conditions of oat (28). The aim of this study to evaluate of genetic variations of oat genotypes under the sufficient and efficiency of irrigation.

MATERIALS AND METHODS

A field experiment was carried out during the winter season 2020-2021 –at the experiments field at the Field Crops Department - College of Agricultural Engineering Sciences - University of Baghdad. The soil properties were as shown in Table (1). This research was carried out according to the Randomized Complete Block Design RCBDwithin split plot arrangement using three replicates, The main plots includedirrigation intervals (irrigation when the soil moisture decline 50%, 25% and 10%)).While the second plots included four genotypes introduced into Iraq with a local genotype (Genzania, Anatolia, Plmula, Algoda and Shifa) and coded V1, V2, V3, V4 and V5 respectively. Humidity was measured using the Hydrofarm Active Air 3-Way Meter. Phosphate fertilizer (P_2O_5)was supplied 100 $kg.h^{-1}$ (29).

Table 1. Field soil characteristics before planting of oat varieties

	Soil properties	units	Values
	PH		7.5
	EC	$ds.m^{-1}$	3.5
	organic matter	g	0.61
	N .available	$mg.m^{-1}$	2.2
	P. available		4.98
	K .available		85.2
soil texture	Sand	%	49.2
	Silt	%	30
	Clay	%	20.08
	Type of soil	Mixture	

RESULTS AND DISCUSSION

Number of days from seeding to 75% flowering: The results of Table (2) show that the varieties had a significant impact on the number of days from seeding to 75% flowering, The V1 excelled in early flowering with an average of 102.56 days, while the delay variety in flowering was the V5 variety and had an average of 111.56 days, and this could be attributed to the growth rate of the crop and its impact on the flowering . However, varieties with early flowering need lower aggregate temperatures than varieties with late flowering. This is consistent with the findings of(1,3). The results of the same Table show that the irrigation periods had a significant differences on the flowering 75%, as the M3 had a highest effect value about 93.67 days, while M1 took a lowest value of flowering about 118.2 days, due the moisture of soil will be enhance the hormone (foreign), that which control on flowering the plants (26).

Table 2. Effect of irrigation intervals on 75% flowering of oat genotypes

Genotypes	Irrigation intervals M1	M2	M3	Mean
V1	115	102	90.67	102.56
V2	114	104	91.33	103.11
V3	116	106	93	105
V4	120	111	97.67	109.56
V5	126	114	94.67	111.56
lsd5%		1.03		0.59
Mean	118.2	107.4	93.47	
L.SD 5%		0.59		

Flag leaf area (cm^2)

Data in of Table (3) shows that the varieties had a significant impact on the flag leaf area, as the V2 variety was produced the highest average of 67.02 cm^2 compared to other varieties. While the V5 variety the lowest average of 56.48 cm^2, and the reason for this be attributed to the nature of the genetic could combination and their ability to adapt to the environment conditions due to of gene expression capacity .These are consistent with (15,19,23), The results of Table (3)reveal that the irrigation coefficients had a significant differences.The M1 hadan average of leaf area about 65.2 cm^2 compared with other treatments , The M3 produced the lowest average of leaf area about 58.09 cm^2. The reason of that could be block of water irrigation reducing of size cell and loss of pressure on the cell wall (7,21). The results of the same Table show that the interaction between two variables had significant differences in the flag leaf area, as the V4 x M2 combination had the highest average of 75.81 cm^2 compared with V5 x M3 combination gave the lowest yield of 44.04 cm^2.The results of this study was agree with (16).

Table 3. Effect of irrigation intervals in the flag leaf area (cm^2) of oat varieties

Genotypes	Irrigation intervals M1	M2	M3	Means
V1	52.09	73.13	64.58	63.27
V2	67.55	70.71	62.8	67.02
V3	51.35	57.01	66.34	58.23
V4	75.81	69.89	52.7	66.13
V5	69.2	56.2	44.04	56.48
lsd5%		3.24		1.87
Means	63.2	65.39	58.09	
LSD 5 %		1.87		

Number of tillers.m^{-2}

The V4 had the highest average of 620 .m^{-2} compared to V2 gave the lowest average of 497.1 tillers, The reason for this could be attributed to the genetic combination produced of the varieties in their ability to tillers and this is consistent with (11).The irrigation periods had a significant effect on the number of tillers ant M1 had the highest average of 676 tillers m^{-2} compared to the M3 transaction recorded the lowest average of 460.28 tillers m^{-2} .Thesoil moisture soil caused shortage of growing season (9, 42, 43, 45).The same Table shows that the combinations had a significant effect, for the combination V4xM1 with the highest average for the number of tillers with an average of 756 tillers .m^{-2} compared to V1xM3 gave the lowest value about 432 tillers .m^{-2} and the reason for this could be attributed to the ability of the varieties to responder irrigation (3,18, 39).

Table 4. Effect of irrigation intervals on number of tillers per m^2 of oat varieties

Genotypes	Irrigation intervals M1	M2	M3	Means
V1	540	692	454	562
V2	435.3	624	432	497.1
V3	456.7	632	434.7	507.8
V4	576	756	528	620
V5	486	676	452.7	538.23
lsd5%		49.17		28.39
Means	498.8	676	460.28	
LSD 5%		28.39		

Number of fertility tillers

Number of fertile tillersis one of the most important traitsthat affect the grain yield.The results of the number of spikes, and the increases in the number of fertile spikes proudest an increases in the number of grains per unit area. The results of Table (5) show that the genotypes had a significant differences on the fertiletiller, as the V4 variety produced the highest average of 492.77 tiller.m^{-2} compared to other varieties that gave the lowest averages, as the V2 variety gave the lowest average of 369.87 m^{-2}fertile tiller .m^{-2} and the reason for this be due to the ability of the varieties for tillering (46). The results of Table (5) show that the irrigation periods have a significant effects on the traits of the number of fertile tillers , as the M1 gave the highest average of 586 fertile tiller .m^{-2} compared to , as the M3 where recorded the lowest about of 289.58 fertile tiller .m^{-2} and the reason for this could be attributed to the fact that the water stress encourage of tillers to develop (43) . The results of Table (5) show a significant differences between the combinations, as the combination V4 x M1 had the highest average and was 666 fertile tillers compared to V2 x M3 recorded the lowest about 261.3 m^{-2} fertile tillers .This result consists with (31, 38).

Table 5. Effect of irrigation intervals to the number of fertility tillers of oat varieties

Genotypes	Irrigation intervals			Means
	M1	M2	M3	
V1	419	602	283.3	434.77
V2	314.3	534	261.3	369.87
V3	335.7	542	264	380.57
V4	455	666	357.3	492.77
V5	365	586	282	411
lsd5%		49.17		28.39
Means	377.8	586	289.58	
L.SD5%		28.39		

Weight of 250 grains (g)

Grains weight one of the important of thegrain yield, which reflects from photosynthesis capacity. The results of Table (6) show that the varieties had a significant differences on grain weight of 250 grains, as the V3 produced 11.43 g compared to V5 produced the lowest 7.77 g .This consistent with (21) and the reason that attributed to the genetic difference among varieties, which led to increaseschlorophyll content in leaves (20,21,24,37). The results of Table (6)showed that there are significant differences between the irrigation periods of weight 250 grains, as the M1 gave the highest average (10.58 g), compared M3 gave the lowest average (7.67 g).This is consistent with the results of (27) .They are show the decrease of seed weight because of water stress at grain filling (33, 44).The results of the Table(6) below show that the combinations had a significant effects on grain weight and V3xM1 gave the highest value about 13.24 g compared to V1xM1 gave the lowest average of 4.16 g . This consists with (2,6,12)

Table 6. Effect of irrigation intervals to theweight of (250 grain) of oat varieties

Genotypes	Irrigationintervals			Means
	M1	M2	M3	
V1	13.19	11.41	4.16	9.59
V2	6.51	10.66	6.79	7.99
V3	13.24	10.47	10.57	11.43
V4	9.13	10.49	9.37	9.66
V5	6.01	9.86	7.44	7.77
lsd5%		0.57		0.33
Means	9.62	10.58	7.67	
LSD 5%		0.33		

Grain yield (ton .h^{-1})

The results of Table 7 show that the varieties had a significant difference grain yield,and V4 produced the highest average of 7.49 ton.h^{-1} compared with V3 gave value about 5.83 ton .h^{-1}. The results of Table(7) show that the irrigation periods had a significant differencesof grain yield. While, the M1 gave the highest average of 7.46 tons .h^{-1} compared to M2 and M3 gave of 6.76 and 5.08 tons.h^{-1}. There were significant differences between the M2 and M3 and had about 6.76 and 5.08 tons.h^{-1}. The sufficient of water caused less ofcarbohydrate in the grains (38, 40,45).

Table7. Effect of irrigationintervals in ton .h^{-1} of the oat varieties

Genotypes	Irrigationintervals			Means
	M1	M2	M3	
V1	6.49	7.63	4.79	6.3
V2	6.7	6.92	4.33	5.98
V3	6.43	6.76	4.29	5.83
V4	7.47	8.62	6.4	7.49
V5	6.73	7.38	5.59	6.56
lsd5%		0.55		0.32
Means	6.76	7.46	5.08	
LSD 5%		0.32		

Genetic variances

The results of Table (8) show that the second irrigation level had the highest values of genetic variation for all traits except for the total yield trait, and the values were (24.6, 117.965, 3223.467, 3223.467, 3223.467 and 12.143) for agronomic traits: the number of days of planting up to 75%, flowering, the flag leaf area , the number of seedlings, the number of fertile tiller , and the weight of 250 grains respectively. This indicated that

the availability of optimum-environment conditions to the genotypes(3,5). The coefficient of phenotypic and environmental variation recorded the highest values at the second level of irrigation, while the inheritance ratio of the characteristics had the flag leafarea, the number of tillers, the number of fertile tillers and the weight of 250 grains the highest possible at the second irrigation level compared to the other two levels.these results consist with(3,5, 46)
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Table 8. Some genetic parameters of oat varieties under three irrigation intervals.

	Genetic parameter		75% flowering	Flag leaf area	Number of tillers	Fertility of tiller	weight of 250	yield
M 1	σ2 G	Genetic variance	22.8	88.594	2476.8	2476.8	0.303	0.464
	σ2 E	Environment variance	0.267	3.395	1041.6	1041.6	0.016	0.223
	σ2 P	variance Phonotypic	23.067	91.989	3518.4	3518.4	0.319	0.687
	P.C.V	phenotype coefficient of variance	4.059	16.51	8.775	10.122	5.343	11.108
	G.C.V	genotypic coefficient of variance	4.035	16.203	7.362	8.493	5.205	9.129
	Heritability (broad sense)%		98.844	96.31	70.396	70.396	94.892	67.537
M2	σ2 G	Genetic variance	24.6	117.965	3223.467	3223.467	12.143	0.152
	σ2 E	Environment variance	0.6	4.389	547.867	547.867	0.187	0.057
	σ2 P	variance Phonotypic	25.2	122.354	3771.333	3771.333	12.331	0.209
	P.C.V	phenotype coefficient of variance	4.674	17.502	12.312	16.255	36.522	6.757
	G.C.V	genotypic coefficient of variance	4.618	17.186	11.382	15.028	36.243	5.765
	Heritability (broad sense)%		97.619	96.413	85.473	85.473	98.48	72.786
M3	σ2 G	Genetic variance	7.75	64.668	1213.267	1213.267	6.058	0.798
	σ2 E	Environment variance	0.517	3.305	964.6	964.6	0.14	0.044
	σ2 P	variance Phonotypic	8.267	67.973	2177.867	2177.867	6.198	0.842
	P.C.V	phenotype coefficient of variance	3.076	12.609	10.139	16.115	32.468	18.073
	G.C.V	genotypic coefficient of variance	2.978	12.299	7.568	12.028	32.099	17.596
	Heritability (broad sense)%		93.75	95.138	55.709	55.709	97.745	94.792

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