Yield and yield components of durum cultivar grown under different irrigation and nitrogen levels

Mohammed A. Hussain [1], MuradJan M.M. Noori [2], Rezan Essa Mosa[3]

1- Department of Field Crops, College of Agricultural Engineering Sciences, University of Duhok, Duhok, Kurdistan Region, Iraq.

2- Department of Soil and Water sciences, College of Agricultural Engineering Sciences, University of Duhok, Duhok, Kurdistan Region, Iraq.

3-Department of Soil and Water sciences, College of Agricultural Engineering Sciences, University of Duhok, Duhok, Kurdistan Region, Iraq.

- **Date of research received 17/2 / 2020 and accepted 17 /8/2020**

Abstract

The experiment was conducted to determine the effect of different irrigation levels (L_0, L_{50}, L_{75} and L_{100}) from field capacity and four nitrogen rate (0, 50, 75, 100 kg ha^{-1}) on wheat genotypes during (2017-2018). The experiment units were laid out in Randomize Complete Block Design (RCBD) arrangement in a split plot design with irrigation in main plots and nitrogen in sub plots with three replications.

The results revelated that, plant height, leaf area, weight of grain/spike, number of seeds spike^{-1}, 1000. grain weight and grain yield were significantly effected by nitrogen and irrigation levels over control. The results also showed the maximum yield and yield components was obtained from nitrogen applied 75 and 100 kg ha^{-1} . From irrigation, the results was found that the tallest plant (76 cm) , leaf area (155.83 cm^2), highest seed weight (9.52 g), number of seed spike^{-1} (60.36), 1000-grain weight (46.22 g) and highest grain yield (93.88 g) were obtained with irrigation 100% from field capacity. The yield and yield contributing characters were more affected due to application of different irrigation and nitrogen levels and maximum grain yield was obtained by L_{100} and 100 kg ha^{-1} and giving 103.23g.

Also the results showed highly positive related between nitrogen and seeds weight 5 spikes, 1000- grain weight and weight of seeds with values 0.929, 0.922 and 0.893 respectively, while the relationship with irrigation gave highly positive relationship with number of seed spike (0.958), weight of seeds (0.931), flag leaf area (0.911) and seed weight in spike with value 0.902.

We conclude that the optimum grain yield was produced in supplemental irrigation (L_{100}) and nitrogen rate of 100 kg ha^{-1}. The results indicated that the irrigation and nitrogen levels would be most advantageous for wheat production.

Keyword: Irrigation. Nitrogen level. Durum Wheat.

الحاصل و مكوناته للحنطة الخشنة النامية تحت مستويات مختلفة من الري و السماد النيتروجيني

محمد علي حسين[1] مراد جان مظفر[2] ريزان عيسى موسى[3]

1- قسم المحاصيل الحقلية/كلية علوم الهندسة الزراعية/جامعة دهوك/دهوك/إقليم كردستان العراق.
2- قسم علوم التربة و المياه/كلية علوم الهندسة الزراعية/جامعة دهوك/ دهوك/إقليم كردستان العراق.
3- قسم علوم التربة و المياه/كلية علوم الهندسة الزراعية/جامعة دهوك/ دهوك/إقليم كردستان العراق.

- تاريخ استلام البحث 17/2/2020 وقبوله 17/8/2020

الخلاصة

أجريت الدراسة في حقل تجارب كلية علوم الهندسة الزراعية – جامعة دهوك لتحديد تأثير أربعة مستويات من الري L0,L50,L75 & L100 من السعة الحقلية و أربعة مستويات من النيتروجين (0 ,50 ,75 و 100 كغم /هكتار) على احد التراكيب الوراثية للحنطة الخشبية. وضعت المعاملات في الواح منشقة و باستخدام تصميم القطاعات العشوائية الكاملة و بثلاث مكررات. أظهرت النتائج ان الصفات (ارتفاع النبات و المساحة الورقية و وزن بذور السنبلة وعدد البذور في السنبلة و وزن 1000 بذرة و الحاصل) تاثرت تاثيراً معنوياً بمستويات الري و النيتروجين كما أظهرت النتائج ان اعلى حاصل و مكوناته كانت عند إضافة 75 و 100 كغم نيتروجين/ هكتار كما كان لمستويات الري تاثير على ارتفاع النبات (76 سم) و المساحة الورقية (155.83 سم^2) وزن البذور (9.52 غم) و (60.36) لعدد البذور سنبلة و (46.22 غرام) لوزن 1000 بذرة و اعلى حاصل بلغ (93.88 غرام) عند مستوى الري 100% من السعة الحقلية, اما بالنسبة لمكونات الحاصل هي الأخرى تأثرا تاثيراً معنوياً. اما اعلى حاصل فقد كان عند المعاملة 100 كغم/ هكتار و عند مستوى الري 100% من السعة الحقلية حيث اعطى 103.33 غرام و كذلك أظهرت النتائج وجود علاقة ارتباط موجبة و معنوية بين النيتروجين و وزن السنبلة و وزن 1000 بذرة و حاصل البذور حيث بلغت قيمتها 0.929 و 0.922 و 0.893 على التوالي بينما اظهر الري علاقة معنوية عالية و موجبة مع عدد البذورسنبلة (0.958) و وزن البذور (0.931) و المساحة الورقية (0.911) و وزن بذور السنبلة(0.902).

الكلمات المفتاحية: الري. مستوى النيتروجين. الحنطة الخشنة.

Introduction

Water is considered the most limiting factor for cereal crop production. Environmental conditions are characterized adequate amounts of rain fall during winter (December to February) while, few precipitation events are registered in spring from mid- March to mid-May. However, the unfavorable distribution of rain over the growing season and the year to year fluctuation constitute a major constraint for winter crops growth as durum wheat under those conditions (El-Fadel and Saddek ., 2009).

Mark and Antony (2005); Araus (2002). Reported that water stress not holy affected the morphology of plant but also severely affects the metabolism of the plant. The extent of modification depends upon the cultivar, growth stage duration and intensity of stress, while, Ashraf *et al*., (2001) showed that the water stress at anthesis reduces the pollination and thus number of grains are formed per spike which results in the reduction in the grain yield.

Emam *et al.*, (2009) evaluated different levels of nitrogen fertilizer on grain yield and its components and indicated that grain yield increase with the increase of nitrogen fertilizer. While, Gozubenli *et al*., (2001) reported also to such increase in yield and yield components in rainfed wheat by increasing nitrogen fertilizer, on other the hand excessive use of nitrogen fertilizer in rainfed wheat leads to an increase growth period more vegetative organs and resulting decrease of grain yield and decrease of harvest index, whereas determination the appropriate level of nitrogen in rainfed wheat which caused the maximum yield (Ryan *et al*., (2001) and Ryan *et al.*, (2008)). In general soil nitrogen and irrigation level are the most important factors influencing often interdependently, the growth of plants, According to the results reported by Saeedi *et al.*, (2010): Shirazi *et al.*, (2014): Britto *et al* ., (2014) and Mohammed *et al* ., (2015) indicated that the combination of irrigation and nitrogen levels is the important for optimal production of wheat.

Many researches have been studied the interaction among irrigation and nitrogen levels on some traits of durum wheat such as biomass, tillering ability , grain per spike and grain size at any stage when it occurs, moreover wheat's most sensitive growth stages to water stress with respect to grain yield are stem elongation and booting followed by anthesis and grain filling (Al-Kaisi and Yin 2003: Karam *et al* ., 2009: Liu and Shi, 2013 and Britto *et al* ., 2014).

therefore the objective of the present study was to determine the effect of water irrigation and nitrogen levels on yield and yield components of durum wheat cultivar.

Materials and Methods

Field experiment was conducted during November-July (2017-2018) at the field of College of Agriculture, University of Duhok. The climate of the experimental site is displayed in Figure (1). Four irrigation levels and Nitrogen rates were applied for this study . Irrigation treatment included L_0, L_{50}, L_{75} and L_{100} of field capacity, the total water applied (Irrigation + rainfall) for each water treatment. The water was conducted to the study area by a discharge of 1.6L/hr. using surface irrigation (furrow irrigation) and tried to reach the soil moisture near root zone for depth (0-90) to field capacity which was equal to 32.31% water as a depth with interval of three days between each irrigation process.

Three irrigation regimes (levels) were used in this experiment including: 100%, 75% and 50% of full crop irrigation need (Field capacity). Symbols L_0, L_1 and L_2 denotes the treatments received 100% (752 mm), 75% (632.6mm) and 50% (471.6 mm) of irrigation water throughout the season and these amount of water were applied right after the emergency stage, The variation of soil water content was monitored by using tensiometer and thermo-gravimetric methods at 30 cm increment to a depth 90 cm approximately each 3 days during the growing season, the amount of irrigation water for each level estimated using the following equation O'Kelly, (2004):

$$\text{Moisture percent} = \frac{\text{Wet weight} - \text{dry weight}}{\text{Dry weight}} = 100$$

$d = \Theta_m \text{ x } \rho b \text{ x } D$

Where:

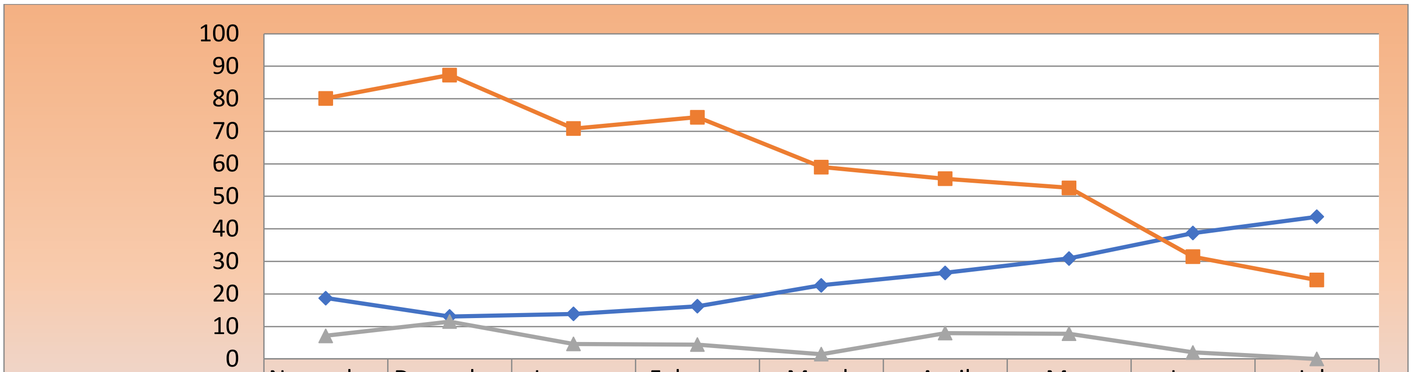
$\Theta_{m =}$ mass wetness (grave metric water content) %

ρb = bulk density gm/ cm^3

D = depth of soil or depth of root zone = cm

Soil samples were taken from the land by digging a soil profile for analysis of some physical properties, (table 1).

Four Nitrogen rats (0, 50, 100, 150 kg ha^{-1}) were applied to each irrigation treatment. Half nitrogen dose were applied as side dressing with the help of three rows hand drill at the time of sowing and remaining half dose applied at the tiller stage, urea were used as a source of nitrogen fertilizers. 100 kg ha^{-1} was applied to all plots at the time of sowing.



	November	December	January	February	March	April	May	June	July
Temperature	18.72	13.06	13.86	16.2	22.63	26.47	30.93	38.71	43.71
Humidity	80.13	87.32	70.85	74.32	59.01	55.4	52.6	31.45	24.26
Precipitation	7.12	11.5	4.64	4.43	1.5	7.96	7.78	2	0

Fig (1) Climatic information for the growing season in November 2017 – July 2018

The experiment was laid out in Randomize Complete Block Design (RCBD) arrangement in a split-plot with irrigation in main plots and nitrogen in sub-plots with three replications for a total 48 plots of 3 m length and 0.25 m between rows, using Simeto durum wheat variety.

All of the cultural management were performed according to plant requirements. The data were recorded on five plants selected randomly for each experiment unit, the studied traits were plant height cm, flag leaf area cm^2, number of grains spike, grain spike weight , 1000-grain weight and grain yield per m^2. The data were statistically analyzed using minitab software package (16) subsequently. The Least Significant Difference (L.S.D) at 5% probability level was used to test the difference among mean values. (Steel and Torrie, 1984).

Table (1): Some physical properties of the soil at research location

Soil Property	Unit	Depth (0-30)
Sand	g kg^{-1}	4.38
Silt		45.21
Clay		50.41
Soil Texture		Silty Clay
Bulk Density	Mg m^{-3}	1.392
Ɵm at (-33)	kPa	32.31
Ɵm at (-1500)	kPa	20.16

Results and Discussion

Yield and yield contributing characters of wheat genotype on irrigation and nitrogen levels were presented in Table 2. All studied characters were significantly affected due to application of nitrogen and irrigation water with exception flag leaf area.

Table (2): Analysis of Variance for Studied Characters

Source of Variance (ANOVA)							
S.O.V.	**d.f**	**Plant Height (cm)**	**Flag Leaf Area (cm^2)**	**Seeds weight in 5 spikes (g)**	**No. of Seeds^{-1} spike**	**1000-grain weight (g)**	**Weight of Seeds (g)**
Replication	2	0.44	105.51	0.01	3.71	15.68	0.03
Nitrogen (N)	3	23.14*	189.53	3.36**	684.21**	339.35**	646.28**
$E_{a(N)}$	6	3.19	103.6	0.01	5.68	14.70	2.12
Irrigation (L)	3	150.72**	370.05**	0.16	187.09**	234.77**	15.35**
N*L	9	16.65*	105.48*	0.14	203.59**	163.12**	16.56**
$E_{b(L)}$	24	6.32	33.98	0.06	9.77	35.61	3.17
Total	47						

** significant effect at probability 0.01 * significant effect at probability 0.05

The effect of nitrogen, irrigation and their interaction was displayed in Table 3, which showed that the plant height increase with each nitrogen levels but maximum plant height was recorded by N_3 level which was 70 cm. Irrigation levels also differed affecting in plant height, crop plants irrigated at L_3 recorded significantly longest plants 76 cm as compared to plants irrigated at L_1 and L_2.

For interaction between nitrogen and irrigation levels L_1 and L_2 had significantly and increasing plant height 10.9% and 11.8 % over L_0N_0 respectively. All nitrogen levels increased plant height by applying nitrogen which might be due to variation of plant height among different irrigation levels as well as heathier plant growth with sufficient availability of nutrients having no moisture stress.

Nitrogen showing a fundamental role in enhancing the productivity of wheat growth and yield parameters as plant height and increasing irrigation frequency decreased Nitrogen uptakes efficiency (N uptake per gram N applied). Similar results were denoted by (Scagel *et al.*, 2012; Million *et al.*, 2007 and Scheiber *et al.*, 2008).

Table (3): Effect of Nitrogen, Irrigation and their interaction on plant height (cm)

Plant height (cm)								
Nitrogen level		Irrigation Level				Mean	LSD for N	
		L_0	L_1	L_2	L_3		0.05	0.01
N_0		63	68	70	67	67	4.75	N.S.
N_1		64	68	72	73	69.25		
N_2		64	72	72	70	69.5		
N_3		64	72	69	76	70		
Mean		63.75	70	70.75	71.5			
LSD for L	0.05	3.00						
	0.01	4.72						
LSD for N*L	0.05	2.30						
	0.01	N.S.						

Analysis of data in Table 4 showed the effect of irrigation, nitrogen and their interaction levels on flag leaf area, as with leaf area, the relative amount of applied nitrogen

Appeared to have a small effects on flag leaf area, while the results of the present study indicated that the levels of irrigation effected flag leaf area and leaf area varied between 124.3 cm^2 for L_1 to 155.83 cm^2 for L_3 with average of 142.45cm^2. The irrigation L_0 level, significantly reduced leaf area due to the reduce in cell division. The deficit of water maximum reduce turgor pressure and hence cell expansion resulting in approximately the same dry mass being contained within as smaller leaf area.

Concerning of combination between rate of irrigation and nitrogen levels are affected significantly ($p \leq 0.05$) on leaf area, the highest value (182.23 cm^2) were obtained by L_2N_2. The previous results are agreement with Abd El-Hmeed, (2005) , Abd El-Hmeed and Omar (2006) and Zeidan *et al .*, (2009).

Table (4): Effect of Nitrogen, Irrigation and their interaction on Flag leaf Area

Flag Leaf Area (cm^2)								
Nitrogen level		Irrigation Level				Mean	LSD for N	
		L_0	L_1	L_2	L_3		0.05	0.01
N_0		115.20	105.77	119.59	142.48	120.76	N.S.	N.S.
N_1		121.48	132.63	120.88	180.93	138.98		
N_2		132.60	131.39	182.23	149.64	148.97		
N_3		120.31	127.41	166.17	150.27	141.04		
Mean		122.40	124.30	147.22	155.83			
LSD for L	0.05	3.00						
	0.01	4.72						
LSD for N*L	0.05	2.30						
	0.01	N.S.						

The results in Table 5 revealed that the effect of nitrogen, irrigation levels and their interaction on seed weight of 5 spikes. Different nitrogen levels had significant influence on seed weight of 5 spikes, the higher weight of seed (10.65gm) was found with N_3 and lowest weight was observed with control, while the irrigation and their interaction did not show significant effect on seed weight of 5 spikes. Similar results were revealed by many researchers like Ryan *et al.,* 2001 and Ryan *et al.,* 2008.

Table (5): Effect of Nitrogen, Irrigation and their interaction on Seeds Weight (g) in 5 Spikes

Seeds weight in 5 spikes								
Nitrogen level		Irrigation Level				Mean	LSD for N	
		L_0	L_1	L_2	L_3		0.05	0.01
N_0		6.91	6.82	8.47	7.22	7.35	4.75	9.78
N_1		7.48	8.15	8.30	9.90	8.46		
N_2		10.38	10.30	10.67	10.36	10.43		
N_3		10.50	10.93	10.58	10.58	10.65		
Mean		8.82	9.05	9.51	9.52			
LSD for L	0.05	N.S.						
	0.01	N.S.						
LSD for N*L	0.05	N.S.						
	0.01	N.S.						

The effect of nitrogen fertilizer were significant on the number of grain spike (Table 6) and the N_2 level gave the maximum number of grain spike 61.12 while the N_0 due to the lowest number of grain spike $^{-1}$ with value 45.08. For wheat has been recommended by various researchers reported that spike number and grain weight because the nitrogen deficiency affects biomass production and solar radiation use efficiency of the plant. The data in the same table indicated that the increase of nitrogen levels due to increase the number of grain spike^{-1}. For the irrigation effect, all irrigation levels differ significantly in number of grain spike^{-1} but the maximum number of grain spike^{-1} was recorded in L_3 which was 60.36, Irrigation levels also differed from one another in affecting number of grain spike . Crop plants irrigated at L_1 recorded significantly minimum number of grain as compared to plant irrigated at L_2 and L_3. Interaction between irrigation and nitrogen levels were effected significantly on the number of grain spike^{-1}, the maximum number of grain spike were obtained by N_3L_2, with value 72.10 followed N_2L_1 which had 67.37. while, the minimum value 40.93 recorded by N_1L_1.From the result in the same table , the combination effect of irrigation and different rate of nitrogen fertilizer applied to wheat plant affected significantly on the number of grain spike^{-1}.

Table (6): Effect of Nitrogen, Irrigation and their interaction on No. of seeds spike^{-1}

No. of Seeds								
Nitrogen level		Irrigation Level				Mean	LSD for N	
		L_0	L_1	L_2	L_3		0.05	0.01
N_0		41.67	44.17	41.80	52.67	45.08	4.75	9.78
N_1		58.10	40.93	64.77	63.70	56.88		
N_2		58.57	67.37	54.37	64.17	61.12		
N_3		49.60	61.30	72.10	60.90	60.98		
Mean		51.98	53.44	58.26	60.36			
LSD for L	0.05	3.00						
	0.01	4.72						
LSD for N*L	0.05	2.30						
	0.01	3.25						

Grain weight was statistically affected by irrigation and nitrogen levels Table 7. Heaviest grain (46.22g) and (43.12g) were observed at 100 and 150 kg ha^{-1} Nitrogen respectively while lowest grains (37.93g) weight was recorded at zero nitrogen level. Also Irrigation has pronounced effect on 1000-grain weight of wheat, maximum grain weights were observed at 100% irrigation level and followed by 75% for field capacity and obtained (43.31g). The interaction of nitrogen and irrigation levels was found by 100 kg ha^{-1} and 50% of field capacity which was 53.399g, where water increase and nitrogen application increases photosynthesis production.

However, many researchers found that the supplemental irrigation due to increasing 1000-grain weight and the highest amount of water and nitrogen applied, this may be attributed in decreasing 1000. Seed weight. These results were in agreement with obtained by Ashraf *et al.*, 2001, Kamel-Nadia *et al.*, 2007 and Ouda *et al.*, 2010. Grain yield of broad wheat is the foundation of its unique yield component in response to nitrogen and irrigation levels for the yield of wheat crop.

Table (7) Effect of Nitrogen, Irrigation and their interaction on weight of 1000-grain (g)

Weight of 1000 seeds								
Nitrogen level		Irrigation Level				Mean	LSD for N	
		L_0	L_1	L_2	L_3		0.05	0.01
N_0		32.79	36.70	39.12	43.10	37.93	4.75	9.78
N_1		29.34	35.72	49.82	38.40	38.32		
N_2		40.46	45.84	38.22	47.96	43.12		
N_3		43.12	53.39	44.60	43.77	46.22		
Mean		36.43	42.91	42.94	43.31			
LSD for L	0.05	3.00						
	0.01	4.72						
LSD for N*L	0.05	2.30						
	0.01	3.25						

Grain yield is highly influenced nutrition and irrigation. Irrigation, nitrogen and their interaction significantly affected grain yield of durum wheat Table 8. Higher grain yield (109.55g) was recorded at 100 kg ha^{-1} while lower grain yield (66.12g) was obtained at zero nitrogen.Application of irrigation also affected grain yield maximum grain yield 93.88 g was observed at 100% of field capacity followed by 75% of field capacity 93.32 g while the lowest grain yield (86.86g) were obtained L_0 Level, proper growth and development of wheats needs favorable soil moisture and nitrogen in the root zone. The interaction between nitrogen and irrigation was found significantly (Table 8). Highest grain yield (117.48g) was noted at 100 kg ha^{-1} with 100% of field capacity, while lower grain yield (61.23g) was obtained by zero nitrogen level with 50% of field capacity, Irrigation dissolve the fertilizer and was made available to the crop for proper growth and development, Maximum grain yield can be assessed in term of three yield components to the namely the number of seed spike^{-1}, 1000-grain weight and spike weight. The researchers (Kamel-Nadia *et al.*, 2007, Zeidan *et al.*, 2009: and Abdulkhalek *et al.*, 2015) obtained the same results.

Table (8) Effect of Nitrogen, Irrigation and their interaction on weight of grain(g)

Weight of Seeds								
Nitrogen level		Irrigation Level				Mean	LSD for N	
		L_0	L_1	L_2	L_3		0.05	0.01
N_0		69.55	61.23	63.59	70.12	66.12	4.75	9.78
N_1		63.77	76.73	90.93	81.63	78.26		
N_2		110.90	109.71	109.67	106.30	109.15		
N_3		103.23	108.40	109.08	117.48	109.55		
Mean		86.86	89.02	93.32	93.88			
LSD for L	0.05	3.00						
	0.01	4.72						
LSD for N*L	0.05	2.30						
	0.01	3.25						

Concerning to correlation coefficient between nitrogen and irrigation on plant height, Flag leaf area, weight of seed spike, number of seeds spike^{-1}, 1000- grain weight and grain yield were presented in Table 9. The results exhibited positive relation between nitrogen and all studied traits except flag leaf area and the value ranged between 0.5882 to 0.929. various researchers reported that the amount of nitrogen was increased the spike weight, also the nitrogen significantly affect the number of seed spike and 1000-Grain weight therefore availability of nitrogen to wheat during various of it growth and development is an important factor influencing the yield and yield component (Mohammed *et al.,* 2015) While the irrigation showed positive related with all traits except 1000- grain weight , the highest value (0.9583) of correlated between irrigation and No. of seed spike $^{-1}$. These results are in line with seleiman *et al.*, 2011 founding that increasing number of irrigation increased grain yield, number of grains spike $^{-1}$ and 1000 grain weight.

Table (9): Simple correlation Coefficient between Nitrogen and Irrigation levels with wheat genotypes traits

	Plant Height (cm)	Flag Leaf Area (cm^2)	Seeds weight in 5 spikes (g)	No. of Seeds spike^{-1}	1000- grain weight (g)	Weight of Seeds (g)
Nitrogen (N)	**0.8567***	**0.5882**	**0.929****	**0.7887***	**0.9224****	**0.893****
Irrigation (L)	**0.771***	**0.9115****	**0.9029****	**0.9583****	**0.6473**	**0.9314****

*, ** Significant at 0.05 and 0.01 probability respectively

References

1- **Abd El-Hmeed I.M. and Omar A.E. 2006**. Response of Bread Wheat to some Fertilization treatment. In the 31st international conference for statistics, computer science and its application. 2006. Pp-1-6.

2- **Abd –Hmeed, I. M. 2005** Response of Two newly Released bread wheat Cultivars to different Nitrogen and Phosphorous fertilizer Levels. In. the 1st Sci. Cout, Cereal Crops. Joun 20-21, Alexandria, Egypt.

3- **Abdulkhalek. A.A; R. KH. Darwesh; Mona A. M. El-Mansoury. 2015**. Response of some wheat varieties to irrigation and nitrogen fertilization using ammonia gas in north Nile Delta Region. Annals of agricultural science 60, 2. P:245-256.

4- **Al-Kaisi MM, Yin XH. 2003.** Effects of nitrogen rate, irrigation rate and plant population on corn yield and water use efficiency. Agron J 95: 1475-1482.

5- **Araus, J. 2002.** Plant Breeding and Drought in C3 Cereals: What Should We Breed For?. Annals of Botany, 89(7), pp.925-940.

6- **Ashraf M. Asgher M. N. and M. N. Saseed. 2001.** Evaluation of alternate and regular furrow under Skimmed ground water Application. J. Drain. Water Manage. 5- pp; 13-22.

7- **Britto, D.T., Balkos, K.D., Becker, A., Coskun, D., Huynh, W.Q. & Kronzucker, H.J. 2014.** Potas- sium and nitrogen poising: Physiological changes and biomass gains in rice and barley. Can. J. Plant Sci. 94: 1085-1089.

8- **El-Fadel, M. and S. Saddek. 2009.** Waste water management along the Mediterranean coast: a treatment application decision case study. J. Nat. Resour. Life Sci. Educ., 29:116 124.

9- **Emam, Y., Kouchi, S. & Shokoufa, A. 2009.** Effect of different N fertilization levels on grain yield and yield components of wheat under irrigated and rain-fed farming. Iranian Journal of Agricultural Research. 7(1): 321-331.

10- **Gozubenli, H., Ulger, C. and Sener, O. 2001.** The effect of different nitrogen doses on grain yield and yield-related characters of some maize genotypes grown as second-crop. J. Agric. Fac. C.U., 16: 39-48.

11- **Kamel-Nadia, H. ; M. A. Youssef; Saeed-Seham M.N.A. and Abrahim. 2007.** Effect of hardening and Water Stress on Growth and ana tomical features of wheat plant. Eygpt . J. Appi. Sci 22; pp 1-27.

12- **Karam, F., Kabalan, F., Breidi, J., Rouphael & Y., Oweis, T. 2009.** Yield and water-production functions of two durum wheat cultivars grown under different irrigation and nitrogen regimes. Agricultural Water Management. 96(4): 603– 615.

13- **Liu D and Shi Y .2013.** Effects of different nitrogen fertilizer on quality and yield in winter wheat. Adv J Food Sci Tech 5(5):646-49.

14- **Mark T, Antony B. 2005.** Abiotic stress tolerance in grasses. From model plants to crop plants. Plant Physiol 137:791793.

15- **Million J. T. Reager and C Larsen. 2007.** Water use and Fertilizer response of Azalea using Several No- Leach Irrigation Methods. Hort Technology. 17: 21-25.

16- **Mohammad, K., Seyyed, M. and Mohammad, S. 2015.** Effect of Irrigation and Nitrogen levels on Yield and some traits of Barley. Biological Forum – An International Journal, 7(1), pp.470-476.

17- **Mohammed Y. Mohammed .S; S. Ibrahim A; Shah F., K. Jamil. 2015.** The effect of Nitrogen application rates and Timing of First irrigation on wheat growth and yield. International .J. Agric. Innovations and research 2(4) : 645- 653.

18- **Ouda Samiha. A; R. Abou- Elenin and M.A Sherif. 2010.** Simulation of the effect of irrigation water saving on wheat yield at middle Egypt. In : Fourteenth internation Water Technology Conference IWTC. Cairo, Egypt . pp ; 407-419.

19- **O'Kelly, B.C., 2004.** Accurate determination of moisture content of organic soils using the oven drying method. Drying Technology, 22(7), pp.1767-1776.

20- **Ryan, B.F., Joiner, B.L. and Cryer, J.D. 2012.** MINITAB Handbook: Update for Release. Cengage Learning.

21- **Ryan, J., Estefan, G. and Rashid, A. 2001.** Soil and plant analysis Laboratory Manual. ICARDA, Alippo, Syria, and NARC, Islamabad, Pakistan. (2nd Ed.): 139 -140.

22- **Ryan, M. H., Mclnerney, J. K., Record, I. R., and Angus, J. F. 2008.** Zinc bioavailability in wheat grain in relation to phosphorus fertiliser, crop sequence and mycorrhizal fungi. J. Sci. Food Agric. 88, 1208–1216.doi: 10.1002/jsfa.3200.

23- **Saeedi, M., Moradi, F., Ahmadi, A., Sepehri, R., Najafian, G. & Shabani, A. 2010.** Effect of late- season drought stress on physiological traits and source-sink relations in two wheat bread cultivars (Triticum aestivum *L.*). Iranian Journal of Agricultural Sciences. 12(4): 167-176.

24- **Scagel, C.F., G. Bi, L.H. Fuchigami, and R.P. Regan. 2012.** Irrigation frequency alters nutrient uptake in container-grown Rhododendron plants grown with different rates of nitrogen. HortScience 47:189–197.

25- **Scheiber. S.M., Beeson. R.C., Chen. J., Wang. Q and B. pearson. 2008.** Evaluation of Irrigation frequency and Quantity of leaf Gas Exchange, Growth and Nitrate Leaching of Coleus in a simulated land Scape. Hort Science-43;881-884.

26- **Seleiman. M, Abd- Aal . S, Ibrahim .M and G. Zahran. 2011.** Productivity. Grain and dough quality of breed wheat grown different water regimes . J. of acro crop sci. 2(1): 11-17.

27- **Shirazi, S.M., Zulkifli, Y., Zardari, N.H. & Ismail, Z. 2014.** Effect of irrigation regimes and nitrogen levels on the growth and yield of wheat. Ad- vances in Agriculture. 5: 1-6.

28- Steel, R.G.D. and J.H. Torrie .1984. Principles and Procedures of Statistics. 2 nd Ed., pp. 172–7. McGraw Hill Book Co. Inc., Singapore.

29- Zeidan, E.M. ; I.M Abd-El-Hameed; A.H. Bassiouny and A.A. Waly . 2009. Effect of Irrigation Intervals. Nitrogen and organic fertilization on Yield, Yield attributes and crude Protein content of some wheat cultivars in proceeding of 4th conference on recent Technologies in Agriculture Conference, Giza, Egypt – November 3-5, 2009. Pp-298-307