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PERFORMANCE OF WHEAT CULTIVARS TO IRRIGATION TREATMENTS AND DIFFERENT NITROGEN SOURCES UNDER CALCAREOUS SOIL.

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ABSTRACT: *Two field experiments were conducted at Nubaria Agricultural Research Station in two successive seasons 2012-2013 and 2013-2014 to study the performance of wheat cultivars (V_1=Misr$_1$and V_2= Sids12),four irrigation (I_1= irrigation water equals 50% of crop evapotranspiration (ETc), I_2 = irrigation water equals 75 % of (ETc) I_3= irrigation water equals 100% of (ETc), and I_4= irrigation water equals 125% of (ETc) and nitrogen source (N_1= Ammonium nitrate and N_2 = Ammonia gas)on wheat biological, grain yields, yield components, water requirements and productivity of water.*

Results showed that, biological and grain yields, plant height, number of spikes /m^2, number of kernels / spike and1000 kernels weight were significant affected by the interaction irrigation, nitrogen source and cultivar in both seasons. The highest values of biological and grain yields were 24.333 and 7.500 ton.ha^{-1} in the first season respectively, while in the second season, values were 26.333 and 9.500 ton.ha^{-1},which obtained by irrigation with water equals to 100% of ETc, fertilization by gas ammonia with cultivarSids12 (I_3 N_2 V_2).

The total applied irrigation water for I_3 irrigation were 37.0 and 40.1 cm in both seasons, respectively. The highest values of productivity of irrigation water (PIW) were 2.00 and 2.62kg.m^3, in the first and second seasons, respectively.

Key words: *Wheat – irrigation- cultivars - nitrogen source*

INTRODUCTION

Wheat (*Triticum aestivum, L*.) is the most strategic cereal crop in the world as well as in Egypt. Many efforts are continuously paid for increasing wheat productivity to decrease the gap between production and consumption. This included vertical and or horizontal expansion. Increasing wheat production per unit area can be achieved by breeding, improvement and applying the optimum cultural practices including irrigation and fertilization. Within the arid and semi-arid regions, water shortage is a major limitation for crop production. Wheat crop needs sufficient available water and nitrogen to achieve optimum yields, quality and adequate grain-protein content.

In Egypt, wheat production does not meet the current demands. The Egyptian government is giving efforts to reduce the imported quantity to less than 50% of the total consumption (Abdrabbo *et al.*, 2012). Crop yield, increase depends upon improving the efficiency of water use (Li *et al.,* 2001). Over the last decades studies have been conducted on the regulation of watering and fertilization in arid and semi-arid regions. (De Juan *et al.,* 1999 and Li *et al.*, 2001). Wajid *et al*., (2002) reported that, wheat produced the highest grain yield by applying irrigation at definite growth stages. Crop water requirements are directly related to crop evapotranspiration (ETc) and vary depending on variety and growth stages. Evapotranspiration involves a highly complex set of processes, which are influenced by many factors related to climatic conditions. These conditions includes precipitation, meteorology factors and soil moisture. Aggarwal *et al.,* (1986), showed that water use efficiency (WUE) for wheat decreased with increasing evapotranspiration (ET). Mossa and Abdel-Maksoud (2004) found that evapotranspiration (ET) value was increased as supplemental irrigation increased in wheat crop. Evapotranspiration ranged from 338 - 382 mm at one third of full supplemental irrigation to 434 - 453 mm at full supplemental one.

Siam *et al.,* (2012) showed that, plant height and dry weight per plant had a significant response to ammonia gas levels in combination with micronutrients. Siam *et al.*, (2008) indicated that plant fresh and dry weights, weight of ear leaf, ear weight, 100-grain weight, yield and yield components were significantly affected by the application of ammonia gas fertilizer, ammonium sulphate and urea in descending order. In general, the highest values of vegetative growth and yield components were obtained when the maize plants received ammonia gas fertilizer at the rate of 140kgN/fad. While, the lowest values were obtained from urea at the rate of 100kg N/fad. Mirbahar *et al.*, (2009) indicated that water stress significantly reduced height, spike length, spikelet per spike, grains per spike and 1000-grain weight of all 25 wheat varieties. Abdelraouf *et al.,* (2013) showed that, decreasing the irrigation requirements (IR) from 100% to 50%, significantly decreased most of growth characters i. e; yield and yield attributes and protein, while, water use efficiency, significantly increased. However, decreasing IR from 100% to 50 % decreased, grain, straw, and biological yield /fad from 1.91 to 1.27, from 4.66 to 3.48 and 6.57 to 4.75 ton/fad, respectively. Akram *et al.,* (2014), indicated that, water use efficiency increased with increasing rate of deficit irrigation regimes. Abdelkhalak *et al.,* (2015) showed that, the irrigation treatment gave the lowest values for water consumptive use, grain, straw, biological yield and 1000-grain weight. Nitrogen fertilizer as gas ammonia up to 90kg N fad^{-1} decreased all studied characters, except, yield which has insignificant difference between nitrogen levels. Significant differences were detected among the three wheat varieties in all studied characters during both seasons. Misr1 cultivar was superior and gave the highest value of all studied characters and yield response to water factor (Ky) followed by Misr2.While, water productivity (WP) decreased with increasing irrigation events and nitrogen levels and reached the maximum values at three irrigation treatments and at 90 Kg N fad $^{-1}$. So, irrigating during growing season and applying 75 Kg N fad^{-1} in the form of gas ammonia gave the highest values of yield and yield components of Misr1 wheat cultivar under North Delta conditions. Zaki *et al.*, (2016) indicated that, different sources of nitrogen fertilizer had significant effect on all characters of yield and yield components in two seasons, except, for number of spikes /plant. In addition, interaction between wheat cultivars and nitrogen sources was detected for growth characters except for leaf area /plant at 110 days after sowing. While, plant height, number of tillers /plant, grain yield/plant, grain yield/fad, straw yield/fad, biological yield /fad were significantly affected by the interaction between wheat cultivar and nitrogen source.

The objectives of this work were to study the effects of wheat cultivars, irrigation treatments and nitrogen source on biological, grain yield, yield components, water requirements and productivity of water.

MATERIALS AND METHODS

Two field experiments were carried out during the winter seasons of 2012 -2013 and 2013 - 2014 at the experimental farm of Nubaria Agricultural Research Station. Soil samples were taken before sowing to determine soil physical, and chemical properties (Page *et al.,* 1982), and some soil hydro-physical parameters. Results of analysis were presented in Tables 1 and 2.

Table 1: chemical properties of soil samples.

Soil depth (Cm)	Total N%	Available U g/g		Soluble cations Meq/l				Soluble anions, Meq/l			pH	EC ds/m
		K	P	K+	Na+	Mg++	Ca++	Cl-	So4--	HCO3-		
0-30	0.09	131	2.1	1.20	6.11	1.68	7.81	9.80	2.77	4.23	8.4	1.68
30-60	0.03	107	1.7	1.11	5.71	2.67	8.71	9.44	3.44	5.32	8.3	1.82

Table 2: Field capacity, wilting point, available soil moisture and bulk density at the experimental site.

Soil Depth (cm.)	Field capacity (%)	Wilting point (%)	Available water (%)	Bulk density (g.cm-3)
0-15	26.7	14.8	11.9	1.11
15-30	24.4	12.6	11.8	1.17
30-45	23.8	11.9	11.9	1.19
45-50	20.7	11.3	9.4	1.22
Average	23.9	12.7	11.25	1.17

The studied treatments included two cultivars, four irrigation treatments and two different nitrogen sources. The experimental design was a split-split-plot involving main treatments (irrigation), sub main treatments (nitrogen sources) and sub-sub main (wheat cultivars) with three replicates. Irrigation treatments were;

I_1= Irrigation water equals to 50% of crop evapotranspiration (ETc) based on class A Pan.

I_2= Irrigation water equals to 75 % of ETc.

I_3= Irrigation water equals to 100 % of ETc.

I_4= Irrigation water equals to 125 % of ETc.

The different nitrogen sources were:

N_1= Ammonium nitrate at the of 100 kg N.fad^{-1}

N_2= Gaseous ammonia 82%, at the rate of 100 Kg N.fad^{-1}.

Wheat cultivars were: Misr1 and Sids12.

Plot area was 42 m^2, treated with 30 Kg P_2O_5/fad.(as calcium super phosphate 15%), 48 kg K_2O/fad (as potassium sulphate 48%). Wheat grains of Misr1 and Sids12 cultivars were sown on November 25th and December 5th, whereas, harvested by 10th and 12^{th,} May, in the first and second seasons, respectively. Data were obtained from the center of each plot (30m^2) to avoid border effects.

Agronomic traits were determined:

1- Plant height (cm) was measured from the soil surface to the tip of the main spike at maturity, excluding owns.
2- Number of spikes per m^2 was recorded as the number of spike per m2.
3- Number of kernels per spike was determined as the average of number for kernels per ten spikes taken random from each plot.
4- Thousand kernel weight was calculated as the weight of a 1000- grain sample.

5- Grain yield was determined as the weight of grain harvested for the inner rows per unit area and converted to grain ton per hectare.
6- Biological yield was determined as total weight of all above ground dry matter of each plot and converted to biological ton per hectare.

Irrigation water was controlled and measured by using water flow meter connected to an irrigation pump placed very close to the experimental plots to ensure high water application efficiency. The total amounts of the precipitation were 134.2 and 78.2 mm in the first and second seasons, respectively, (Table 3).

The potential evapotranspiration (ETp) in mm/day values, that were calculated according to Class A pan evaporation method (F.A.O, 1979), were used to calculate the amounts of applied irrigation water as follows:

$$ETc = ETp \times Kc,$$

$$ETp = E\ pan \times K\ pan$$

Where:

ETc = Crop evapotranspiration in mm/day

ETp = Potential evapotranspiration in mm/day,

Kc = Crop coefficient (for wheat crop as reported by (F.A.O.1984),

E pan = Pan evaporation daily values in mm/day (Meteorological station in Nubaria research station),

K pan = Pan coefficient, K pan values depend on the relative

Humidity, wind speed and site condition (bare or cultivated) K pan value of 0.75 was used for the experimental site .

Daily water requirements (WR) in mm/day were calculated as follows:

$$WR = \frac{ETc}{Ea\,(1 - LR)}$$

Where:

Ea= Application efficiency % (70 %for control surface irrigation system)

LR= Leaching requirements (20%of WR in Calcareous soils)

Productivity of irrigation water (PTW) was calculated according to the following equation (Ali *e. al.,* 2007)

$$PIW = \frac{\mathrm{GY}}{IW}$$

Where:

PIW= Productivity of irrigation water (Kg grain m^{-3})

GY = Grain yield (Kg fad^{-1})

IW = Water applied ($m.^3 fad^{-1}$)

Data were statistically analyzed according to Steel and Torrie (1980) for all studied traits using SAS Program (2007).

Table 3: Precipitation in mm during 2012/2013 and 2013/2014 growing seasons.

seasons	2012-2013	2013-2014
Month	Precipitation in mm	Precipitation in mm
Nov	8.2	7.8
Dec	42.0	19.5
Jan	61.2	19.8
Feb	13.1	13.2
Mar	3.0	11.1
Apr	3.6	6.8
May	3.1	0.0
Total	134.2	78.2

RESULTS AND DISCUSSIONS

1- Biological and grain yields :

Results of biological and grain yields for the two growing seasons were presented in Tables 4, 5 and 6. Table 4 showed that, biological and grain yields were significantly affected by the irrigation treatments in the two growing seasons. I_3 irrigation treatment produced the highest values of biological and grain yields in the two growing seasons (22.708 and 24.708 ton.ha^{-1}for the 1st and 2nd seasons, respectively). While the other studied three treatment produced less biological yield. Biological yield of treatment recorded significant increases of (25.8, 13.5 and 3.8 %) and (23.2, 12.3 and 3.4 %) in the first and second seasons, respectively relative to I_1, I_2 and I_4 irrigation treatments, respectively. Also, grain yield of I_3 treatment, surpassed that the other three treatments (7.104 and 9.104 ton.ha^{-1} in the two successive seasons, respectively). The grain yield increases reaches (36.1, 16.1 and 3.7%) and (26.1, 12.1 and 2.9 %) in the first and second seasons compared to I_1, I_2 and I_4 irrigation treatments, respectively. Also, results indicated that, biological and grain yields were significantly affected by different nitrogen source in both growing seasons. N_2 treatment (ammonia gas) produced higher value of biological (21.166 and 23.166 ton.ha^{-1}that represented increases of 5.0 and 4.6%, over the other source in the first and second seasons, respectively. In addition, grain yield increases under ammonia gas treatment (N_2) reached 6.47 and 8.47 ton.ha^{-1}in the first and second seasons, respectively. Biological and grain yield were significantly differed between the two cultivars in the two growing seasons. Biological yield of Sids12 was 21.141 and 23.141 ton.ha^{-1}in the first and second seasons, respectively. Increases over Miser1 cultivar reached 4.8 and 4.4%for in the first and second seasons, respectively. Grain yield of Sids12showed significant increases of 6.0 and 4.5 % in the two seasons, respectively, over Misr1.

Table 5 showed the effect of interactions between irrigation treatment and nitrogen sources (IxN), irrigation and cultivars (IxV) and nitrogen sources and cultivars (NxV) on biological and grain yields. Data indicated that, irrigation water equals to 100% of ETc and application of ammonia gas (I_3N_2), gave the highest values of biological and grain yields. While, the least significant values were obtained with irrigation water equals 50% of ETc and ammonium nitrate (I_1N_1). Also, irrigation water equals 100% of ETc and Sids12 Cultivar (I_3V_2) gave the highest values of biological and grain yields. While the least significant values were obtained from irrigation water equals 50% of ETc with Misr1 cultivars (I_1V_1).

Table 6 showed that biological and grain yields were significantly affected by the interaction among irrigation, nitrogen source and cultivars (IxNxV), in both study seasons. Irrigation water equals 100% of ETc, application of ammonia with Sids12 cultivar (I_3 N_2 V_2) gave the highest values of biological and grain yields in the two growing seasons. The obtained results were in agreement with those reported by Abdelraouf *et al.,* (2013) AbdElkhalek *et al.,* (2015) and Zaki *et al.,* (2016). Abdel Aziz *et al.,* (2010) found that, anhydrous ammonia was more effective in increasing straw yield over ammonium nitrate. Ammonia gas easily combines with organic matter in soils and resist leaching and loss, therefore, it is readily utilized by crop all over the growing season resulting in higher values of biological and grain yields.

2- Yield components :

The differences in yield components, number of spikes /m^2, number of kernels /spike, and 1000-kernels weight (g), in 2012/2013 and 2013/2014 were listed in Table 4,5 and 6. Table 4 showed that, all characters of yield components were significantly affected by irrigation treatments in both seasons. Irrigation treatments I_3 and I_4 gave the highest values of all characters. Also, number of spikes/m^2 in both seasons, and no of kernels /spike in the second season are only significantly affected by nitrogen source.

Table 4: Biological and grain yields, yield components and Plant height (cm) as affected by irrigation treatments, nitrogen sources and wheat cultivars during 2012-2013 and 2013-2014 growing seasons.

Characters treatment	Biological yield ($Ton.ha^{-1}$)		Grain yield ($Ton.ha^{-1}$)		No of spikes ($spike.m^{2}$)		No of kernels ($kernel.spike^{-1}$)		1000-kernlals weight (g)		Plant height(cm)	
Season treatments	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
I_1	18.041d[ə]	20.041c	5.220c	7.220c	384.6d	412.6d	49.9b	77.8c	43.1c	47.1c	102.66c	104.91c
I_2	19.991c	21.991b	6.119b	8.119b	439.4c	463.4c	60.1a	80.7c	44.5bc	48.5bc	105.75b	108.83b
I_3	22.708a	24.708a	7.104a	9.104a	524.6a	556.6a	63.0a	91.2a	47.0ab	51.0ab	108.33a	110.91a
I_4	21.875b	23.875a	6.845a	8.845a	506.1b	534.1b	64.3a	85.7b	48.2a	52.2a	109.16a	111.58a
L.S.D at 0.05	0.814	0.924	0.291	0.492	18.0	18.4	6.2	3.4	3.1	3.2	2.17	1.61
N_1	20.141b	22.141b	6.175b	8.175a	453.3b	481.3b	59.3a	85.4a	45.1a	49.1a	105.70a	103.54a
N_2	21.166a	23.166a	6.470a	8.470a	474.0a	502.0a	59.3a	82.3b	46.4a	50.4a	107.25a	109.58a
L.S.D at 0.05	0.575	0.653	0.206	ns	13.0	13.0	ns	2.4	ns	ns	ns	ns
V_1	20.166b	22.166b	6.136b	8.136b	476.7a	504.7a	54.6b	82.6b	43.2b	47.2b	108.79a	111.16a
V_2	21.141a	23.141a	6.508a	8.508a	450.7b	478.5b	63.9a	85.1a	48.2a	52.2a	104.16b	106.95b
L.S.D. at 0.05	0.575	0.653	0.206	0.348	13.0	13.0	4.4	2.4	2.2	2.3	1.53	1.14
L.S.D. at 0.05 level significant interactions.												
I*N	**	**	**	**	**	**	*	**	*	*	*	**
I*V	**	**	*	**	**	**	**	**	**	**	*	**
N*V	*	*	ns	ns	ns	ns	*	*	**	**	**	**
I*N*V	**	**	**	**	**	**	*	**	*	**	**	**

L.S.D. at (0.05): Least significant differences at 0.05 level.

*, ** and ns: significant at 0.05, 0.01 levels and not significant different at 0.05 levels, respectively.

ə: Means followed by similar letters are not significantly different at 0.05 level.

Table 5: Effect of interaction between irrigation and nitrogen sources (I x N), irrigation and cultivar (I x V) and nitrogen sources and cultivar (N x V) on yield, its components and plant height (cm) during 2012-2013 and 2013-2014 growing seasons.

Characters	Biological yield ($Ton.ha^{-1}$)		Grain yield ($Ton.ha^{-1}$)		No of spikes ($spike.m^2$)		No of kernels ($kernel.spike^{-1}$)		1000-kernlals weight (g)		Plant height (cm)	
Season Treatments	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Interaction IN												
$I_1 N_1$	17.500	19.500	4.941	6.491	377.5	405.5	50.7	78.7	42.0	46.0	100.83	102.83
I_1N_1	18.583	20.583	5.500	7.500	391.6	419.6	49.0	77.0	44.2	48.1	104.50	107.00
I_2N_1	19.483	21.483	6.016	8.016	405.5	429.5	58.7	80.6	43.6	47.6	105.33	108.83
I_2N_2	20.500	22.500	6.221	8.221	473.3	497.3	61.4	80.8	45.6	49.6	106.16	108.83
I_3N_1	21.667	23.667	6.916	8.916	510.8	542.8	60.0	92.0	46.0	50.1	107.50	110.16
I_3N_2	23.750	25.750	7.291	9.291	538.3	570.3	66.0	90.3	48.0	52.0	109.16	111.66
I_4N_1	21.960	23.916	6.825	8.825	519.5	547.5	67.7	90.3	48.6	52.6	109.16	112.33
I_4N_2	21.833	23.833	6.866	8.866	492.6	520.6	60.8	81.1	47.7	51.8	109.16	110.83
L. S.D at 0.05	1.222	1.321	0.450	0.671	30.2	30.2	10.6	4.8	5.2	5.3	4.41	3.84
Interaction IV												
I_1V_1	17.833	19.833	5.025	7.025	395.8	423.8	48.7	76.7	40.9	44.8	103.66	105.8
I_1V_2	18.250	20.250	5.416	7.416	373.3	401.3	51.0	79.0	45.3	49.3	101.66	104.00
I_2V_1	19.500	21.500	5.996	7.996	448.0	472.0	56.0	80.0	41.6	45.6	107.33	110.33
I_2V_2	20.483	22.483	6.241	8.241	430.8	454.8	64.1	81.5	47.6	51.6	104.16	107.33
I_3V_1	22.166	24.166	6.958	8.958	546.6	578.6	57.9	89.9	43.9	47.9	111.66	113.33
I_3V_2	23.250	25.250	7.250	9.250	502.5	534.5	68.1	92.6	50.9	54.2	105.00	108.50
I_4V_1	21.166	23.166	6.566	8.566	516.6	544.6	55.9	83.9	46.6	50.6	112.50	115.16
I_4V_2	22.583	24.583	7.125	9.125	495.5	523.5	72.6	87.5	49.8	53.8	105.83	108.00
L. S.D at 0.05	1.312	1.422	0.437	0.662	35.0	35.0	8.7	5.4	4.2	4.3	3.27	2.85
Interaction NV												
$N1V_1$	19.708	21.708	6.037	8.037	464.4	492.4	55.6	83.6	41.9	45.8	108.91	111.58
N_1V_2	20.515	22.575	6.312	8.312	442.2	470.2	62.9	87.1	48.3	52.3	102.50	105.50
N_2V_1	20.625	22.625	6.235	8.235	489.1	517.1	53.6	81.6	44.6	48.6	108.66	110.75
N_2V_2	21.708	23.708	6.704	8.704	458.8	486.8	65.0	83.0	48.2	52.1	105.83	108.41
L. S.D at 0.05	1.732	1.771	n.s.	n.s.	n.s.	n.s.	7.8	5.5	3.2	3.3	3.05	2.92

Table 6: Effect of interaction between irrigation, nitrogen source and cultivar (IxNxV) on yield, its components and plant height (cm) during 2012-2013 and 2013-2014 growing seasons.

Characters	Biological yield ($Ton.ha^{-1}$)		Grain yield ($Ton.ha^{-1}$)		No of spikes ($spike.m^{2}$)		No of kernels ($kernel.spike^{-1}$)		1000-kernlals weight (g)		Plant height (cm)	
Season treatments	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Interaction (INV)												
$I_1N_1V_1$	17.333	19.333	4.750	6.750	390.0	418.0	49.6	77.6	39.1	43.1	103.33	105.33
$I_1N_1V_2$	17.666	19.666	5.733	7.133	365.0	393.0	51.7	79.7	45.0	49.0	98.33	100.33
$I_1N_2V_1$	18.333	20.333	5.300	7.300	401.6	429.6	47.8	75.8	42.7	46.7	104.00	106.30
$I_1N_2V_2$	18.833	20.833	5.700	7.700	381.6	409.6	50.2	78.2	45.7	49.7	105.00	107.66
$I_2N_1V_1$	19.000	21.000	5.916	7.916	406.0	430.0	56.3	80.3	39.7	43.7	107.33	110.66
$I_2N_1V_2$	19.966	21.966	6.116	8.116	405.0	429.0	61.1	81.0	47.4	51.4	103.33	107.00
$I_2N_2V_1$	20.000	22.000	6.076	8.076	490.0	514.0	55.6	79.6	43.4	47.4	107.33	110.00
$I_2N_2V_2$	21.000	23.000	6.366	8.366	456.6	480.6	67.2	82.1	47.8	51.8	105.00	107.66
$I_3N_1V_1$	21.166	23.166	6.833	8.833	526.6	558.6	58.1	90.1	42.4	46.4	111.66	113.33
$I_3N_1V_2$	22.166	24.166	7.000	9.000	495.0	527.0	62.0	94.0	49.7	53.7	103.33	107.00
$I_3N_2V_1$	23.166	25.166	7.083	9.083	566.6	598.6	57.7	89.7	45.3	49.4	111.66	113.33
$I_3N_2V_2$	24.333	26.333	7.500	9.500	556.7	542.0	74.2	91.0	50.7	54.7	106.66	110.00
$I_4N_1V_1$	21.333	23.333	6.650	8.650	535.0	563.0	58.6	86.6	46.3	50.3	113.33	117.00
$I_4N_1V_2$	22.500	24.500	7.000	9.000	504.0	532.0	76.9	94.0	51.0	55.0	105.00	107.66
$I_4N_2V_1$	21.000	23.000	6.483	8.483	498.3	526.0	53.3	81.3	46.9	50.9	111.66	113.33
$I_4N_2V_2$	22.666	24.666	7.250	9.250	487.0	515.0	68.3	81.0	48.6	52.6	106.66	108.33
L.S.Dat0.05	1.628	1.849	0.583	0.984	36.8	36.8	12.4	6.8	6.2	6.4	4.34	3.23

Number of spikes/m^2 is the main yield component contributes to grain yield production. Results in Table 6 show that, the number of spikes.m^{2}in the two seasons were detected for the two studied cultivars under irrigation treatment I_3 (100% ETc) and ammonia gas fertilization. There results might indicate that, using the whole dose of ammonia gas before planting increased availability of nitrogen in early and late tillering stages which increased number of spikes/m^2 in the two cultivars which was reflected in higher grain yield under I_3 N_2 treatments.

Abdel Aziz and Mazen (2010) stated that, anhydrous ammonia reacts with water and increase nitrogen availability in soil. Therefore, wheat growth, tillering, spike development and grain filling might be efficient leading to high grain yield.

Data of number of kernels/spike were presented in Tables 4, 5 and 6. Data revealed that number of kernels/spike of Sids12 wheat cultivar (V_2) is higher than that of Misr1 (V_1) under all treatments indicating genetic variability between these two cultivars. The highest number of kernels/spike was detected in the two cultivars under I_3 N_2 treatments (Table 6). Irrigation with 100% ETc and fertilization with ammonia gas resulted in higher number in kernels/spike for the two cultivars over other irrigation and fertilizer treatments. The treatment I_3 N_2 V_2 produced the highest number of kernels. Number of kernels per spike is an important yield component which is determined at spike initiation stage. Availability of nitrogen and water at this stage increase number of spikelet which results in an increase in number of kernels/spike. I_3 and N_2 increased the availability of nitrogen and water in that growth stage which indicated the superiority of ammonia over the second source of ammonia in wheat production.

Wheat grain weight is determined at the grain filling stage following anthesis and fertilization. Grain weight is highly affected by the translocation of assimilates from leaves and stems to grains. I_3 and I_4 produced the highest grain weight, which reflects the importance of the availability of water in grain filling period. Nitrogen fertilization with ammonia gas produced heavier kernels under I_3 irrigation treatment confirming previous results.

Table 5 showed the interaction between irrigation and nitrogen source (I x N), irrigation and wheat cultivars (I x V) and nitrogen source and cultivar (N x V). Results indicated significant effect of the interaction (I x N) and (I x V). Results showed a significant effect of the interaction between N x V on all characters of yield components except for number of spikes/m^2 in both seasons. Table 6 showed that, no of spikes/m^2, number of Kernels/spikes, 1000-kernelsweight and plant height were significantly affected by the interaction between irrigation, nitrogen source and wheat cultivars (I x N x V), in both seasons.

Results of yield components clarify the superiority of the treatment I_3 N_2 V_2 in biological and grain yield.

Although plant height is mainly controlled by genetic make-up it was highly affected by environmental conditions. The highest values of plant height were detected under the two irrigation treatments I_3 and I_4. Misr1 cultivar was taller than Sids12. Higher values of plant height contribute to biological yield. The obtained results are agreement with those reported by Siam *et al.,* (2008), Siam *et al.,* (2012) and Mir bahar *et al.,* (2009).

4- Water requirements and productivity of irrigation water (PIW) :

The month and seasonally amount of irrigation water (water requirements) to the wheat crop according to the irrigation treatments during the two growing seasons are listed in Table 7. The highest monthly value of applied irrigation water occurred during March in both seasons for the all irrigation treatments. The total amount of water requirement for the 50, 75, 100 and

125% of ETc irrigation treatments were 28.4, 33.0, 37.0 and 42.7 cm in the 1nd season and 29.4, 34.6, 40.1 and 44.4 cm in the 2th season respectively. The obtained results are agreement with the results of Li *et al* (2001), Wajid *et al.,* (2002), and Moussa and abdel-Maksoud (2004).

Table 8 showed that, the maximum values of irrigation water productivity (PIW) were obtained when irrigation water equals 50% of ETc, with application of ammonia gas and with cultivation Sids12 wheat cultivar (I_1 N_2 V_2) in both seasons. The maximum values of PIW were 2.00 and 2.62 kg wheat grain yield per m^3 water applied in the first and second seasons, respectively. PIW decreased with increasing the mounts of irrigation water, and reached the minimum value when wheat plants were irrigated with of water equals 125% of ETc, with application of ammonia gas, and with cultivation of Misr-1 cultivar (I_4 N_2 V_1) in both seasons. These results are agreement with the results of Aggarwal *et al.,* (1986), Li *et al.,* (2001), Akram *et al.,* (2014) and Zaki *et al.,* (2016).

Table 7: Monthly and total (water requirements in cm as affected wheat by irrigation treatments during 2012-2013 and 2013 -2014 growing seasons.

Season	Treat	Nov.	Dec.	Jan	Feb	Mar	Apr	May	Total
2012-2013	I1	1.2	7.1	5.9	4.1	4.4	4.1	1.6	28.4
	I2	1.2	7.1	5.9	4.3	6.8	5.3	2.4	33.0
	I3	1.2	7.1	5.9	4.5	8.4	6.8	3.1	37.0
	I4	1.2	7.1	5.9	4.7	11.1	8.7	4.0	42.7
2013-2014	I1	-	9.5	5.8	3.6	4.6	3.7	2.2	29.4
	I2	-	9.5	5.8	4.5	6.3	5.6	2.9	34.6
	I3	-	9.5	5.8	4.9	8.6	7.2	4.1	40.1
	I4	-	9.5	5.8	5.1	10.2	9.2	4.6	44.4

Table 8 : Productivity of irrigation water (PIW) for grain yield (kg.m^3) during 2012-2013 and 2013-2014 growing seasons.

treatments	Productivity of irrigation water (PIW)	
	2012 -2013	2013-2014
$I_1N_1V_1$	1.67	2.30
$I_1N_1V_2$	1.80	2.43
$I_1N_2V_1$	1.87	2.48
$I_1N_2V_2$	2.00	2.62
$I_2N_1V_1$	1.79	2.29
$I_2N_1V_2$	1.85	2.35
$I_2N_2V_1$	1.84	2.33
$I_2N_2V_2$	1.93	2.42
$I_3N_1V_1$	1.85	2.20
$I_3N_1V_2$	1.89	2.24
$I_3N_2V_1$	1.91	2.27
$I_3N_2V_2$	2.00	2.39
$I_4N_1V_1$	1.56	2.16
$I_4N_1V_2$	1.64	2.24
$I_4N_2V_1$	1.52	2.12
$I_4N_2V_2$	1.70	2.31

CONCLUSIONS

From the obtained results it could be concluded that:

1- Maximum biological and grain yields were obtained by irrigation with amount of water equals 100% of ETc, application of ammonia gas and cultivation sids-12 wheat cultivar.

2- There was significant effect due to the interaction between irrigation treatments, nitrogen sources and wheat cultivars on plant height and yield and yield components (no. of spikes/m^2, no of Kernel /spike, 1000-kernel weight).

3- Seasonal range of irrigation requirements for wheat crop was 37.0 to 40.1cm.

4- The heights value of the productivity of irrigation water for wheat crop was obtained by irrigation with amount of water equals 50% of ETc, with application of ammonia gas and with cultivation Sids-12 wheat cultivar.

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سلوك اصناف القمح لمعاملات الري ومصادر مختلفه من النيتروجين تحت الأراضي الجيريه

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المخلص العربي

نفذت تجربة حقلية في موسمي 2012–2013 و 2013 –2014 بمحطة بحوث النوبارية لدراسة سلوك صنفين من القمح لمعاملات ري ومصدرين مختلفين من التسميد النيتروجيني. صممت التجربة في قطع منشقة مرتين، القطع الرئيسية هى معاملات الري والقطع الشقيه الاولى مصدرين مختلفين من التسميد النيتروجيني والقطع المنشقه الثانيه صنفين من القمح. كانت معاملات الري هى: I_1– الري بكمية مياه تعادل 50% من البخر نتح المحصولي (ETc), I_2– الري بكمية مياه تعادل 75% من البخر نتح المحصولي (ETc), I_3– الري بكمية مياه تعادل 100% من البخر نتح المحصولي (ETc), I_4– الري بكمية مياه تعادل 125% من البخر نتح المحصولي (ETc) .

معاملات التسميد النيتروجيني: N_1– التسميد بسماد نترات الامونيا (صلب)

N2– التسميد بغاز الامونيا (غاز)، الاصناف V_1– مصر 1 و V_2– سدس 12

اظهرت النتائج وجود تأثير معنوي لمعاملات الري ومصدري التسميد النيتروجيني والاصناف على المحصول البيولوجي والحبوب خلال موسمي النمو. كما اوضحت النتائج التأثير المعنوى للتفاعل بين معاملات الري ومصدري التسميد الينتروجيني والاصناف على المحصول البيولوجي والحبوب وطول النبات علاوة على مكونات المحصول (عدد السنابل / متر مربع وعدد الحبوب فى السنبله ووزن 1000 حبة).

اظهر التفاعل بين معاملات الري والتسميد والاصناف (I_1 N_2 V_2) اعلي متوسط انتاجية للمحصول البيولوجي 24.333 و 26.333 طن/هكتار خلال موسم الزراعة الاول والثانى على التوالي .

كما اظهرت النتائج ايضا ان اعلي متوسط انتاجية لمحصول الحبوب 7.500 و 9.500 طن/هكتار للتفاعل بين معاملات الري والتسميد والاصناف (I_3 N_2V_2) خلال الموسم الاول والثانى علي التوالي.اوضحت الدراسة ايضا ان كمية مياه الري الكلية المضافة لمعاملة الري) I_3 (كانت 37.0 و 40.1 سم خلال موسمي النمو على التواليوأعلي انتاجية لمياه الري (PIW) كانت لمعاملة الري) I_1 (2.00 و 2.62 كجم لكل متر مكعب مياه مضاف خلال موسمي النمو على التوالي .

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