Egypt. J. Agron. **Vol. 39,** No.2 pp.137- 148 (2017)

Effect of Irrigations Number on Yield and Yield Components of Some Bread Wheat Cultivars in North Nile Delta of Egypt

Dalia A. A. Elhag #

Agronomy Department, Faculty of Agriculture, Kafrelsheikh University,. Kafrelsheikh, Egypt.

A FIELD experiments were conducted in the two successive seasons 2013/2014 and 2014/2015 at the experimental farm of Faculty of Agriculture, Kafrelsheikh University-Egypt, to investigate the effect of number irrigation on growth, yield and yield components of some wheat cultivars (*Triticum aestivum*, L.). A strip-plot design with three replications was used. Four irrigation treatments were; Ir1= given one irrigation after sowing at tillering stage, Ir2= Ir1+ one irrigation at elongation stage, Ir3= Ir2 + one irrigation at booting stage, and Ir4= Ir3 + one irrigation after flowering stage. Ir1, Ir2, Ir3 and Ir4 were assigned in the horizontal plots, while, the three wheat cultivars; Sids 12, Misr 1 and Sakha 93 were randomly distributed in vertical plots. Results indicated that the effect of irrigations significantly affected number of days to heading and maturity, plant height, number of spikes/m^2, 1000-grain weight, number of grains/spike, grain yield, straw yield and harvest index(%). There were highly significant differences among irrigation treatments for all studies traits. Four irrigation produced the highest values of number of days to heading and maturity, plant height, number of spikes/m^2, 1000-grain weight, number of grains/spike, grain yield, straw yield and harvest index (%). There were highly significant differences among wheat cultivars for all character under study. Misr 1 recorded the highest values for number of days to heading and maturity, plant height, number of grains/spike, grain and straw yield. Sids 12 recorded the highest values for 1000-grain weight and harvest index. Sids 12 recorded the highest values for number of fertile tillers/m^2, and 1000-grain weight with normal or control irrigation treatment (Ir 4). Misr 1 produced the highest grain yield, straw yield, number of grains/spike comparing with the other cultivars Sakha 93 and Sids 12. Decreasing number of irrigations from four to three decreased grain yield of the cultivars Sids 12, Misr 1 and Sakha 93 by 6%, 10% and 11%, respectively. Sid 12 cultivar may be used successfully for improving production of wheat in North Delta area under shortage of irrigation water.

Keywords: Wheat genotype, Growth stages, Water treatment, Grain yield and yield component.

Introduction

Wheat (*Triticum aestivum L.*) is one of the leading cereal crops regarding area and production in the world. (Karrou et al., 2012) indicated that wheat is important most strategic crop in Egypt. However, at the national level there is a wide gap between wheat production and consumption varying from 40 to 50%. Farmers are trying to increase production via excess irrigation water. Under the water shortage, facing Egypt due to the high annual rate of increasing national population along with the fixed allocation from Nile River, the main source of water for Egypt. This situation results in decreasing the annual capita shape from water for different purposes to less than the water poverty edge of 1000 m^3. Moreover, this situation is expected to the less than the security level of less than 500 m^3 in the few coming deciles. At this situation, it is difficult to make any progress at any sector of development. They use basin conventional technique that requires huge amounts of water. In Egypt agriculture relies greatly on irrigation water from Nile river, where the agricultural sector consumes more than 84%, of the available water resources (El-Beltagy & Abo-Hadeed, 2008).

#Corresponding author email: dalia_elhag@yahoo.com
DOI :10.21608/agro.2017.680.1059

The increasing demands of wheat is mainly due to the fast growth of human population, therefore maximizing wheat production should be achieved through cultivation of the high yielding wheat cultivars and appropriate agronomic practices such as irrigation, sowing pattern and its date, fertilizer and weed control. Gab Alla (2007), Shehab El-Din (2008), EL-Shamy (2009), Moayedi et al. (2010). Sharshar (2010), Al Tahar et al. (2011), El hag (2011) Zafarnaderi & Mohammadi (2013) and Omar et al. (2014) showed that days to heading, days to maturity, plant height, number of spikes/m^2, grain yield, straw yield, harvest index, number of grains/spike, and 1000-grain weight were affected by different irrigation number. They Also, summarized that the values behind the mentioned traits were increased with increasing irrigation number and decreased under less number of irrigation.

Wheat breeders are continuously trying to improve the wheat yield under irrigation number conditions. Moayedi et al.(2010), Sharshar (2010), Akbari et al. (2011), El hag (2011, 2012), Ngwako & Mashiqa (2013), Qamar et al. (2013), Sing & Singh (2013), Omar et al. (2014) El- hag (2016) and Kandil et al. (2016) reported that day to heading and maturity, plant height, number of spike m^{-2}, number of grain $spike^{-1}$, 1000-grain weight, grain and straw yield and harvest index were significantly affected by wheat cultivars.

Therefore, the main objective of this investigation was to find out the most sensitive growth stages to irrigation from some bread wheat cultivars owing to achieve maximum yield in North Nile Delta.

Materials and Methods

A field experiment was conducted at the Faculty of Agriculture– Kafrelsheikh University, Egypt. The site is located at 30.94 North Latitude, 30.11 East Longitude with an elevation of about 6 m above sea level., during 2013/2014 and 2014/2015 seasons, to study the performance of three bread wheat cultivars under different number of irrigations. The preceding crop was rice (*Oryza sativa*, L) in both seasons.

Composite soil sample was randomly collected from the site at the depths of 0 to 30 cm with the help of 5 cm diameter auger before soil preparation in both seasons. These samples were analyzed for physical and chemical characteristics by standard methods of analysis. Results of physical and chemical analysis in both seasons are shown in Table 1.
seasons.

A strip plot design with three replications was used. The vertical plots were assigned to irrigation numbers and the horizontal plots to the three wheat cultivars (Sids 12, Misr 1 and Sakha 93). The name and pedigree of these genotypes are presented in Table 2.

Seeds of the three wheat cultivars at the rate of 350 seeds/m^2 were drilled in rows 20 cm apart on flat land. Sowing was done on last week of November 26 and 30 in 2013 and 2014 seasons, respectively. The experimental field was fertilized with 15.5 kg P_2O_5/fad in the form of calcium superphosphate (15.5 % P_2O_5) during seedbed preparation (one faddan= 4200m^2). Nitrogen fertilizer at the rate of 70 kg N/fad in the form of urea (46.5% N) was applied in one dose at the first irrigation (Ir1). Then, all plots were irrigated immediately.

Four irrigation treatments were applied after the sowing watering; (Ir1) = one irrigation at tillering stage, (Ir2) = Ir1+ one irrigation at elongation stage, (Ir3) = Ir2 + one irrigation at booting stage, and (Ir4) = Ir3 + one irrigation after flowering stage (Table 3).

Other cultural practices were done as the local farmers implemented in the area base the technical package of Agric, Res. Center (ARC). The sub-plot area which allocated to irrigation treatments was 4.2 m^2 harvest area was(2.8 m^2). Each irrigation treatment was around by planting wheat (5 m width) and canal (2.5 m) as a border between treatments.

In both seasons, the following traits were estimated:- number of days to heading and days to maturity, plant height, number of spikes/m^2, number of grains/ spike, 1000 grain weight, grain yield, straw yields and harvest index. Grain yield and straw yield were converted to t/fed.

All data collected in the two growing seasons were subjected to analysis of variance and means were compared using Duncan Multiple Range Test (Duncan, 1955). All statistical analysis was performed using analysis of variance technique by

"MSTAT-C (1990)" computer software package.

TABLE 1. Mechanical and chemical properties of the experimental soil at the experimental site during 2013/014 and 2014/015 seasons.

Character	2013/14	2014/15
Chemical analysis		
N (Avalable ppm)	17	19
P (Avalable ppm)	18.7	22.3
K(Available ppm)	285	341
Soil pH	8.01	7.80
Mechanical analysis		
Sand %	19.2	18.3
Silt %	39.1	38.5
Clay %	41.7	43.2
Soil texture	clay	clay

TABLE 2. Name and pedigree of three wheat cultivars used in this investigation.

Genotype	Pedigree
Sids 12	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL/4/CHAT"S"/6/ MAYA/VUL//CMH74A.630/4*SX. SD7096-4SD-1SD-1SD-0SD.
Misr 1	OASIS/SKAUZA//4*BCN/3/2*PASTOR CMSS00Y01881T-050M-30Y-030M-030WGY-33M-0Y-0S
Sakha 93	Sakha 92/TR 810328 S 8871-1S-2S-1S-0S

TABLE 3. Irrigation scheduling at different critical stages of wheat growth.

Irrigation treatment	Wheat growths stage			
	Tillering	Elongation	Booting	Flowering
Ir1	+†	-††	-	-
Ir2	+	+	-	-
Ir3	+	+	+	-
Ir4	+	+	+	+

†+ = irrigated and ††- = non irrigated

Discusion

Number of days to heading and maturity

Data in Table 4 showed that number of irrigations recorded the highest significant effects for days to heading and maturity in both growing seasons. Decreasing irrigation number caused early heading and maturity in both seasons. The earliest heading and maturity were recorded for Ir 1 81.6, 82.4, 131.0 and 133.1 days, respectively. The effect of decreases number of irrigations for days to heading due to decreased the vegetated growth and ripening period. Could be the availability of appropriate environmental conditions such as soil moisture (Ir 4), good nutrient conditions which resulting treatment Ir4 reflects in increasing the period of vegetativegrowth and increases the number of days from planting until deadline and physiological mature. These results were agreed with that obtained by Gab Alla (2007), Sharshar (2010), El-hag (2011) and Omar et al. (2014). The differences among wheat cultivars are highly significant regarding number of days to heading and maturity in both seasons. Sakha 93 was the earliest one and recorded 84.9, 82.7 for heading and 136.9 and 139.7 days for maturity in the first and second seasons, respectively. The observed significant variation among the cultivars might reflects partially their different genetic backgrounds and environmental condition. These results were in the same direction with Gab Alla (2007), Omar et al. (2014), El-hag (2016) and Kandil et al. (2016).

The interaction between wheat cultivars and irrigation number has highly significant effects on number of days to heading in both seasons and highly significant for maturity in 2014/15 season (Table 5). The earliest heading cultivars and maturity dates were obtained with Sakha 93 under Ir1 (77.7, 80.0 and 129 days). On the other hand, the latest cultivar for days to heading was Misr 1 under Ir4 (109 and 152.7 days) for maturity in 2013/14 season.

Plant height

Variations in plant height due to irrigation number were highly significant in both seasons (Table 4). Treatment (Ir1) produced the shortest wheat plant (81 and 91.3 cm); meanwhile Ir4 produced the tallest plant height of 116 and 120.1 cm in the first and second seasons, respectively. Increase the number of irrigations lead to increased nutrition available and thus increase plant growth especially plant height, increasing the size and number of cells between the internodes, which resulting in increasing plant height. These results are agree with those found by; Gab Alla (2007), Shehab El-Din (2008), EL-Shamy (2009), Moayedi et al. (2010). Sharshar (2010), El-hag (2011), Qamar et al. (2013), Zafarnaderi & Mohammadi (2013) and Omar et al. (2014). Wheat cultivars affected highly significant in the two seasons. Misr 1 recorded the tallest plant height value of110.4 and 114 cm in the first and second seasons, respectively. The differences between varieties are often due to genetic makeup as well as the interaction between genetic makeup and environmental conditions. Omar et al. (2014), El-hag (2016) and Kandil et al. (2016) were recorded the same findings.

Regarding to interaction between wheat cultivars and irrigation treatments, data showed that Misr 1 produce the tallest plant height (125.3 cm) under four irrigations (Ir4) in the first season (Table 5).

Yield components

Number of spikes/m²

Data presented in Table 6 showed that the effect of irrigation treatments on number of fertile tillers/m² had highly significant in the two studied seasons. Irrigation treatment (Ir 4) had recorded the highest number of fertile tillers (420 and 416.7), meanwhile (Ir 1) recorded the lowest number of spikes/m² (216.7 and 211.1) in both seasons, respectively. It is well known that the tillers is initiated in the first stage of growth, but the number of fertile tillers (spike) is controlled by the availability of nutrients and moisture in the following stages and this was clear from the results of the experiment meanswhich indicated that the number of spikes per unit area is gradually increased with increasing number of irrigations. These results are in agreement with those reported by Moayedi et al. (2010), Sharshar (2010), Akbari et al. (2011), Al Tahar et al. (2011), El-hag (2011), Mojtaba et al. (2013), Qamar et al. (2013) , Zafarnaderi & Mohammadi (2013) and Omar et al. (2014). Regarding cultivars effect on number of spikes/m² were insignificant in the first season and significant in the second season (Table 6). Misr 1 recorded 314.0 in the second season; meanwhile Sakha 93 recorded 296.9in the second season. Under normal irrigation many researchers found highly significant different among cultivars due to variation of genetic and increases with more stress. These results are partially inthe line with those reported by Gab Alla (2007), Omar et al. (2014) , El-hag (2016) and Kandil et al.(2016).

The effect of interaction between irrigation

Table 4. Effect of irrigation number, wheat cultivars and their interactions on number of days to heading, number of days maturity and plant height in 2013-2014 and 2014-2015 seasons.

Treatment	Number of days to heading		Number of days to maturity		Plant height (cm)	
Year	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Irrigation treatment (Ir)						
Ir1	81.6d†	82.4d	131.0d	133.1d	81.1d	91.3d
Ir2	87.3c	83.9c	138.1c	142.6c	95.4c	106.0c
Ir3	96.1b	90.4b	144.0b	145.1b	111.0b	115.8b
Ir4	102.2a	100.3a	148.1a	149.1a	116.0a	120.1a
Wheat cultivars (c)						
Sids 12	91.6b	91.3b	141.9ab	144.3a	100.4b	111.5b
Misr 1	98.9a	93.8a	142.1a	143.5ab	110.4a	114a
Sakha 93	84.9c	82.7c	136.9c	139.7c	91.8c	99.4c

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$.

Table 5. Interaction effect between wheat cultivars and irrigation treatments on number of days to heading in 2013/14 and 2014/15, number of days to maturity in 2014/15 and plant height in 2013/14.

Cultivars	(Ir):	Number of days to heading		Number of days to maturity	Plant height
		2013/14	2014/15	2014/15	2013/14
Sids 12	Ir1	80.3ef†	82.3 d-f	133.0ef	80.3i
	Ir2	86.0d	83.3c-e	141.0s	90.7g
	Ir3	95.0c	93.7b	146.0bc	113.7c
	Ir4	105.0b	106.0a	147.7bb	117.0bc
Misr 1	Ir1	86.7d	85.0cd	131.0fg	86.0h
	Ir2	95.0c	85.3cd	138.7d	110.0d
	Ir3	105.0b	96.0b	146.0bc	120.3b
	Ir4	109.0a	109.0a	152.7a	125.3a
Sakha 93	Ir1	77.7f	80.0f	129.0g	77.0i
	Ir2	81.0e	83.0c-f	134.7e	85.7h
	Ir3	88.3d	81.7ef	140.0d	99.0f
	Ir4	92.7c	86.0c	144.0c	105.7e

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$.

Table 6. Effect of irrigation number, wheat cultivars and their interactions for plant height (cm), flag leaf area (cm2) and number of fertile tillers in 2013-2014 and 2014-2015 seasons.

Treatment	Number of fertile spikes/ m^2		1000 grain weight (g)		Number of Grain/spike	
Year	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Irrigation treatment (Ir)						
Ir1	216.7d†	211.1d	37.4d	37.0d	36.2d	37.6d
Ir2	285.4c	274.0c	38.6c	38.0c	51.7c	54.6c
Ir3	332.2b	317.8b	40.9b	40.8b	62.9b	63.7b
Ir4	420.0a	416.7a	43.4a	43.3a	67.9a	70.2a
Wheat cultivars (c)						
Sids 12	312.5	303.8ab	41.1a	40.7a	54.7b	54.8b
Misr 1	325.8	314.0a	39.1b	38.8b	57.0a	59.2a
Sakha 93	302.4	296.9b	40.1ab	39.9ab	52.3c	55.5b

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$

number and wheat cultivars were highly significant in both seasons. Misr 1 recorded the highest number of fertile tillers with irrigation four (Ir 4) in both seasons as presented in Table 7.

1000 grain weight

Grain weight significantly affected by irrigation treatments in both seasons (Table 6). Increased irrigation number gradually increased gradually 1000 grain weight. Irrigation treatment (Ir4) recorded 43.4 and 43.3 g in both seasons, respectively. Increase the availability of moisture and nutrients from the soil to plant lead to increased vegetative growth and thereby increase the metabolic rate and thus storage in grain, thus resulted increasing grain weight. These results are in agreement with those reported by Moayedi et al. (2010), Sharshar (2010), Akbari et al. (2011), Al Tahar et al. (2011), El-hag (2011), Mojtaba et al. (2013), Qamar et al. (2013) , Zafarnaderi & Mohammadi (2013) and Omar et al. (2014). There are significant differences among cultivars for 1000 grain weight in both seasons. Grain weight of the most important characteristics of varieties and feedback to genotype gene. Sids 12 was superior in 1000 grain weight (41.1 and 40.7 g) in both seasons, respectively. These results are in harmony with those found by Gab Alla (2007), Omar et al. (2014), El-hag (2016) and Kandil et al. (2016).

The interaction between wheat cultivars and

Table 7. effect of interaction between wheat cultivars and irrigation number on 1000-grain weight (g) number of grain/spike in 2013/14 and 2014/15 seasons.

Cultivars	(Ir)	Number of spikes/ m^2	1000-grain weight (g)		grain/spike	
		2013/14	2014/15	2013/14	2014/15	2013/14
Sids 12	Ir1	190.0h†	178.3j	38.0e	35.0i	37.0h
	Ir2	260.0fg	250.0h	39.0d	39.0e	51.3f
	Ir3	330.0de	316.7e	41.8bc	44.0b	63.3c
	Ir4	450.0a	440.0b	44.7a	46.0a	67.0ab
Misr 1	Ir1	236.7g	226.7i	36.7g	34.0j	38.7i
	Ir2	303.3e	286.0g	37.0f	37.0f	55.3e
	Ir3	350.0cd	336.7d	39.0d	42.0d	65.0b
	Ir4	473.3b	456.7a	41.3c	44.0b	69.0a
Sakha 93	Ir1	223.3gh	228.3i	37.8ef	36.0h	33.0j
	Ir2	293.0ef	286.0g	38.5de	38.0g	48.3g
	Ir3	316.7de	300.0f	40.6cd	43.0c	60.3d
	Ir4	376.7bc	373.3c	42.0b	45.0ab	67.7ab

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$

irrigation treatments had significant effects on number of 1000 grain weight in both seasons (Table 7). The highest values for 1000 grain weight were produced by Sids 12 cultivars under Ir4, meanwhile Misr 1 had recorded the lowest values (36.7 and 34.0) under Ir1.

Number of grains/spike

Regarding the effect of irrigation treatments on number of grains/spike, data presented in Table 6 showed that there were highly significant effects in both seasons. Irrigation treatment (Ir 4) recorded the highest number of grain/spike (67.9, and 70.2) in the first and second seasons, respectively. Spikelet number determined in the vegetative stage of growth, especially after the tillering stage and until the date of heading the greater availability of appropriate conditions for growth especially moisture and nutrients is increasing the number of grains/spike,. These results are partially in line with those reported by Moayedi et al. (2010). Sharshar (2010), Akbari et al. (2011), Al Tahar et al. (2011), El-hag (2011) Mojtaba et al. (2013), Qamar et al. (2013), Zafarnaderi & Mohammadi (2013), Omar et al. (2014), . The differences among wheat cultivars were highly significant in both seasons. Misr 1 recorded the highest number of grains/spike (57.0 and 59.2) in the first and second seasons, respectively. Number of grains/ spike is the most important component of the yield after the number of spikes per unit area and the different from one to another cultivar is depending on the genetic makeup. These results are in a harmony with Gab Allah (2007), Omar et al. (2014), El-hag (2016) and Kandil et al. (2016).

The interaction between wheat cultivars and irrigation number had significant effects on number of grains/spike in 2013/14 season. The highest values for number of grains/spike were produced by Misr 1 cultivar under Ir4, and the lowest values were recorded by Sakha 93 under Ir1(Table 7).

Yield

Grain yield

Irrigation according to different growth stages plays vital role on wheat productivity as shown in Table 9. Increasing number of irrigations by watering at different growth stages of Ir4 obtained the highest grain yield comparing with other irrigation treatments. In this regard, the mean values of the two seasons for grain yield could be arranged in descending order as, 3.620 > 3.300 > 2.436 > 1.715 t/fad. The states values are for Ir 4, Ir 3, Ir 2 and Ir1, respectively. Comparing with Ir4 (100 %) the treatments irrigation at different stages, the percentage yield for other treatments Ir 3, Ir 2 and Ir1 are 91, 67 and 47%, respectively (Fig 1). Meaning fully irrigation, skipping irrigation at flowering, skipping irrigation booting and flowering and skipping irrigations at elongation, booting and flowering stages (Table 3) decreased grain yield by 9, 33 and 53%, respectively. Therefor skipping irrigation at each growth stages led to decreased yield as; elongation with 20%, booting with 24% and flowering with 9% as states before. Hence, irrigation should be implemented at both stages of elongation and booting stages.

This may be due to the reduction in grains/ spike, 1000 grain weight and mainly number of fertile tillers/m^2. and/or reduction in photosynthesis and translocation of reserves to grains (Fisher & Maurer, 1978 and Keim & Kronstad, 1981). Similar results were obtained by Abdelraouf et al. (2013), Attia & Barsoum (2013), Ghanbari & Tavassoli (2013), Mojtaba et al. (2013), Ngwako & Mashiqa (2013) and Qamar et al. (2013). Data presented in Table 9 show the deferences among wheat cultivars on grain yield.There were highly significant in the first and second growing seasons. Misr 1was recorded the highest grain yield 3.123 and 3.037 t/fad in the first and second seasons, respectively. These results are partially in line with those reported by Ghanbari & Tavassoli (2013), Mojtaba et al. (2013), Ngwako & Mashiqa (2013) and Qamar et al. (2013), Sing & Singh (2013), Omar et al. (2014) , El-hag (2016) and Kandil et al. (2016)

The interaction effect between irrigation treatments and wheat cultivars on grain yield was highly significant and significant in 2013/14 and 2014/15 seasons, respectively. Misr 1 produced the highest grain yield (4.150 and 4.00 t/fad) under irrigation treatment Ir 4. In general ,the three cultivars were produced the highest grain yield with increases number of irrigations (Table 10).

Table 8. effect of interaction between wheat cultivars and irrigation number on 1000-grain weight (g) number of grain/spike in 2013/14 and 2014/15 seasons.

Cultivars	(Ir)	Number of spikes/m²	1000-grain weight (g)		Grain/spike	
		2013/14	2014/15	2013/14	2014/15	2013/14
Sids 12	Ir1	190.0h†	178.3j	38.0e	35.0i	37.0h
	Ir2	260.0fg	250.0h	39.0d	39.0e	51.3f
	Ir3	330.0de	316.7e	41.8bc	44.0b	63.3c
	Ir4	450.0a	440.0b	44.7a	46.0a	67.0ab
Misr 1	Ir1	236.7g	226.7i	36.7g	34.0j	38.7i
	Ir2	303.3e	286.0g	37.0f	37.0f	55.3e
	Ir3	350.0cd	336.7d	39.0d	42.0d	65.0b
	Ir4	473.3b	456.7a	41.3c	44.0b	69.0a
Sakha 93	Ir1	223.3gh	228.3i	37.8ef	36.0h	33.0j
	Ir2	293.0ef	286.0g	38.5de	38.0g	48.3g
	Ir3	316.7de	300.0f	40.6cd	43.0c	60.3d
	Ir4	376.7bc	373.3c	42.0b	45.0ab	67.7ab

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$.

Table 9. Effect of irrigation treatments, wheat cultivars and their interactions on grain yield, straw yield and harvest index in 2013-2014 and 2014-2015 seasons.

Treatment	Grain yield		Straw yield		HI%	
Year	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Irrigation treatment (Ir)						
Ir1	1.750d†	1.680d	2.343	2.395	42.8a	41.3a
Ir2	2.440c	2.430c	3.478	3.511	41.2b	40.9ab
Ir3	3.320b	3.280b	5.178b	5.119b	39.1c	39.1b
Ir4	3.660a	3.580a	6.310a	6.104a	36.8d	37.0c
Wheat cultivars (c)						
Sids 12	2.792b	2.733b	4.165b	4.176b	40.9a	40.2a
Misr 1	3.123a	3.037a	4.820a	4.691a	40.1ab	39.8b
Sakha 93	2.475c	2.457c	3.996c	3.980c	38.9c	38.8c

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$

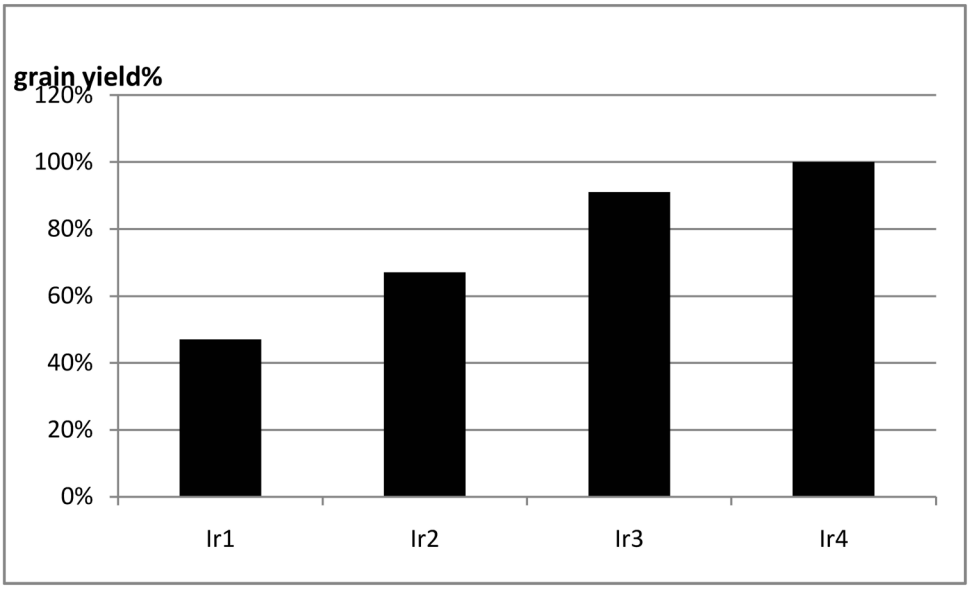

Fig. 1. Relative grain yield for different skipping treatments comparing with Ir4 (control).

Table 10. Interaction effect between irrigation treatments and wheat cultivars on grain yield in (2013/14 and 2014/15) and straw yield in 2013/2014 growing seasons.

Cultivars	Irrigation treatment (Ir):	Grain yield		Straw yield
		2013/14	2014/15	2013/14
Sids 12	Ir1	1.750f†	1.683gh	2.257e
	Ir2	2.583d	2.567e	3.476c-d
	Ir3	3.333d	3.233c	5.037bc
	Ir4	3.500b	3.450bc	5.888ab
Misr 1	Ir1	1.833g	1.767h	2.403e
	Ir2	2.820cd	2.727de	4.060cd
	Ir3	3.673b	3.657b	5.742ab
	Ir4	4.150a	4.000a	7.075a
Sakha 93	Ir1	1.667gh	1.600h	2.367e
	Ir2	1.930e	1.997f	2.897de
	Ir3	2.953c	2.950d	4.753bc
	Ir4	3.350bc	3.283bc	5.967ab

†Mean values in the same column for each trait followed by the same lower-case letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$

Straw yield

Irrigation treatments significantly affected straw yield in both seasons (Table 9). Generally, increases irrigation number increased straw yield as be attained with grain yield. Irrigation treatment Ir1 recorded the lowest straw yield 2.343 and 2.395 t/fad, meanwhile irrigation treatment Ir4 recorded (6.310 and 6.104 t/fad) in 2013/14, 2014/15 seasons, respectively. Increase straw yield of treatment Ir 4 as a result of the availability of soil moisture and thus the necessary nutrients for plants during the growing season to increase the yield components in addition to increase dry matter accumulated. These results are in agreement with those reported by Gab Alla (2007), Shehab El-Din (2008), EL-Shamy (2009), Sharshar (2010), El-hag (2011), Mojtaba et al. (2013), Qamar et al., (2013), Zafarnaderi & Mohammadi (2013) and Omar et al. (2014).

There are significant differences among cultivars regarding straw yield in both seasons. Misr 1 was produced the highest straw yield (4.820 and 4.691 t/fad) in the 2013/14 and 2014/15 seasons, respectively. This result was agreement with those; Mojtaba et al. (2013), Ngwako & Mashiqa (2013), Qamar et al. (2013). Singh & Singh (2013), Omar et al. (2014) , El-hag (2016) and Kandil et al. (2016).

The interaction effect between irrigation treatments and wheat cultivars on straw yield was significant in the first season (Table 10). Misr 1 produced the highest straw yield (7.075 t/fad) under (Ir 4). In general the three cultivars were produced the highest straw yield with increasing number of irrigations.

Harvest index (HI)

Harvest index significantly affected by irrigation treatments in the both seasons. Generally, increases irrigation treatments decreased harvest index. Increase number of irrigations significantly increased the biological yield greater than the rate of increase grain yield which led to decreas harvest index. These results are partially in line with those reported by Gab Alla (2007), Shehab El-Din (2008), EL-Shamy (2009), Sharshar (2010), Al Tahar et al. (2011), El-hag (2011), Qamar et al. (2013) , Zafarnaderi & Mohammadi (2013) and Omar et al., (2014). There are significant differences among cultivars for harvest index in both seasons. Sids 12 produced the highest values of harvest index (40.9 and 40.2 %) in the first and second seasons, respectively. These differences among cultivars are due to variation of grain yield and biological yield of any cultivar. These results are in agreement with those reported by Gab Alla (2007), Omar et al. (2015) and El-hag (2016) and Kandil et al. (2016).

The interaction effect between irrigation treatments and wheat cultivars on harvest index was insignificant in both seasons of study.

Conclusion

This study demonstrates that wheat yield increased by irrigation at different growth stages. Meanwhile, irrigating wheat three irrigations and skipping the watering at flowering could achieve 91% from the maximum yield. Irrigation at both tillering and elongation are essential. Misr1 was surpassed in grain yield and Straw yield. Misr 1 and Sids 12 cultivar yielder than Sakha 93 under this investigation.

References

Abdelraouf, R.E., El Habbasha, S. F., Taha, M.H. and Refaie, K.M. (2013) Effect of irrigation water requirements and fertigation levels on growth, yield and water use efficiency in wheat. *RefaieMiddle-East Journal of Scientific Research,* **16** (4), 441-450.

Akbari, M. H., Galavi, M., Fanaei, H.R., Koohkan, S.H.A. and Poodineh, O. (2011)Effects of deficit irrigation on grain yield and some morphological traits of wheat cultivars in drought - prone conditions. *International Journal of Agri. Sci.* **1**(4), 249-257.

Al Tahar, B., El Hwary, A. and Yagoub, S. O. (2011) Effect of skipping irrigation on growth, yield, yield components and water use efficiency of wheat (*Triticum aestivum* L.) in semi arid Region of Sudan. *Agric. Biol. J. N.* **2**(6), 1003-1009.

Attia, M. A. and Barsoum, M. S. (2013). Effect of supplementary irrigation and bio-fertilization on wheat yield productivity under rainfed conditions. *Alex. J. Agric. Res.* **58**(2),149-157.

Duncun, D.B. (1955) Multiple ranges and multiple F test. *Biometrics,* **11**, 1-42.

El hag, Dalia A. A. (2012) Effect of planting date and nitrogen level on yield and quality of bread and durum wheat. *Ph D. Thesis,* Kafrelsheikh Univ., Egypt.

El hag, Dalia A. A. (2016) Effect of seeding rates on yield and yield components of two bread wheat cultivars. *J. Agric. Res. Kafr El-Sheikh Univ. J. Plant Production,* **42**(1), 29-43.

El hag, Walaa A. A. (2011) Evaluation of some cultivars and lines of bread wheat under low input. *M.Sc. Thesis,* Kafrelsheikh Univ., Egypt.

El-Beltagy, A.T. and Abo-Hadeed, A.F. (2008) The main pillars of the National Program for maximizing the water-use efficiency in the old land. The Research and Development Council. MOALR. (in Arabic); p. 30.

El-Shamy, A. E. A. (2009) Evaluation of some wheat hybrids for drought tolerance. *M.Sc. Thesis,* Kafrelsheikh Univ., Egypt.

Fisher, R.A. and Maurer, R. (1978) Drought resistance in spring wheat cultivars. I. Grain yield responses. *Asut. J. Agric. Res.* **29**, 897-912.

Gab Alla, M.M. (2007) Effect of irrigation numbers on some varieties and strains of wheat *M.Sc. Thesis,* Kafrelsheikh Univ., Egypt.

Ghanbari, A. and Tavassoli, A. (2013) Evaluation of wheat yield in water and nitrogen limited condition. *Tech J Engin & App Sci.* **3** (20), 2702-2705.

Kandil, A. A., Sharief, A. E.M., Seadh, S.E. and Altai,. D. S. K (2016) Role of humic acid and amino acids in limiting loss of nitrogen fertilizer and increasing productivity of some wheat cultivars grown under newly reclaimed sandy soil. *Int. J. Adv. Res. Biol. Sci.* **3**(4), 123-136

Karrou, M. , Oweis, T., Abou El Enein, R. and Sheri, M. (2012) Yield and water productivity of maize and wheat under deficit and raised bed irrigation practices in Egypt. *African Journal of Agricultural Research,* **7**, 1755-1760.

Keim, D.L. and Kronstad, W. E. (1981) Stress response of winter wheat cultivars grown under field stress condition. *Crop Sci*. **21,**11-15.

Moayedi, A. A., Boyce, A. N. and Barakbah, S. S. (2010) The performance of durum and bread wheat cultivars associated with yield and yield component under different water deficit conditions. *Australian Journal of Basic and Applied Sciences,* **4**(1), 106-113.

Mojtaba, K., Miri1, H. and Haghighi1, B. J. (2013) Effect of water deficit stress on grain yield and yield components of wheat cultivars. *International journal of Agronomy and Plant Production*, **4** (6),1376-1380.

MSTATC (1990). A Microcomputer program for Design Management and Analysis of Agronomic Research Experiments Michigan State Univ.

Ngwako, S. and Mashiqa, P. K. (2013) The effect of irrigation on the growth and yield of winter wheat (*Triticum aestivum* L.) cultivars. *Int J Agri Crop Sci.* **5** (9), 976-982.

Omar, A. M., Mohamed, A. A. E., Sharsher, M. S. A ., El-hag, Walaa.A.A. (2014) Performance of some bread wheat genotypes under water regime and sowing methods. *J. Agric. Res. Kafrelsheikh Univ.* **40** (2),327-341.

Qamar, R., Ehsanullah, A., and Ghulam, M. (2013) Effect of irrigation scheduling on the yield and yield components of two wheat (*Triticum aestivum* L.) genotypes. *Crop & Environment,* **4**(1), 1-5.

Sharshar, A. M. (2010) combining ability and heterosis for bread wheat under stress and normal irrigation numbers. *M.Sc. Thesis*, Kafrelsheikh Univ.

Shehab El-Din, M.T.E. (2008) Breading studies on earliness and drought tolerance in bread wheat.*M.Sc.Thesis,* Cairo Univ., Egypt.

Singh, D. and Singh, R. A. (2013) Effect of wheat (*Triticum aestivum*) varieties to sowing methods and time of nitrogen application in late sown condition in Eastern Uttar *Pradesh Research. Journal of Agricultural Sciences,* **4**(3), 341-346.

Zafarnaderi, N. S. A. and Mohammadi, S. A. (2013) Relationship between grain yield and related agronomic traits in bread wheat recombinant inbred lines under water deficit condition *Annals of Biological Research*, **4** (4),7-11.

Received: 21/2/2017
Accepted: 17/5/2017

تأثير عدد الريات على المحصول ومكوناته لبعض اصناف قمح الخبز فى شمال الدلتا بمصر

داليـــا عبدربه عبد العزيز الحاج
قسم المحاصيل- كلية الزراعة جامعة كفر الشيخ - كفر الشيخ - مصر.

أجريت تجربة حقليه بالمزرعة البحثية لكلية الزراعة جامعة كفر الشيخ- مصر، خلال موسمى الزراعة ٢٠١٣/٢٠١٤ و٢٠١٤/٢٠١٥وكان الهدف من هذه الدراسة هو تحديد سلوك بعض اصناف من قمح الخبز تحت ظروف الاجهاد المائى عند أطوار فسيولوجية معينة وذلك على النمو والمحصول ومكوناتة لهذة الاصناف. تم استخدام تصميم الشرائح المتعامدة المنشقة فى ثلاث مكررات. وكانت المعاملات كالاتى : - وزعت أربعة معاملات للرى بعد رية الزراعه فى الشرائح المتعامدة وهى الرى:

1. عند التفريع Ir1
2. عند التفريع واخرى فى مرحلة الاستطالة Ir2 Elongation stage
3. عند التفريع و فى مرحلة الاستطالة ومرحلة ماقبل التزهير Ir3 booting stage
4. عند التفريع و فى مرحلة الاستطالة ومرحلة ماقبل التزهير booting stage و بعد التزهير خروج المتك Ir4 .

اما الاصناف هى (سدس 12، مصر 1 ، سخا 93 فقد تم توزيعها عشوائيا فى الشرائح الافقية.

وتم دراسة الصفات التالية : عدد الايام حتى التزهير والنضج الفسيولوجى، ارتفاع النبات عند الحصاد، عدد السنابل فى المتر المربع، وزن الالف حبة، عدد حبوب السنبلة، محصول الحبوب طن/فدان، محصول القش (طن/فدان) ومعامل الحصاد%

وتظهر النتائج تأثيرعدد الريات معنويا على عدد الايام حتى التزهير والنضج، ارتفاع النبات، عدد السنابل قى المتر المربع، وزن الالف حبة، عدد حبوب السنبله ، محصول كل من الحبوب والقش ومعامل الحصاد. الاربعه ريات سجلت اعلى قيم لعدد الايام حتى التزهير والنضج، ارتفاع النبات، عدد السنابل فى المتر المربع، وزن الالف حبة، عدد حبوب السنبله ، محصول كل من الحبوب والقش ومعامل الحصاد

اختلفت التراكيب الوراثية معنويا فيما بينها فى الصفات تحت الدراسة وهذا يرجع إلى التركيب الجينى لتلك التراكيب بالإضافة إلى التفاعل بينها وبين الظروف البيئية . سجل مصر 1 اعلى القيم لعدد الايام حتى التزهير والنضج، ارتفاع النبات، عدد حبوب السنبلة، ومحصول الحبوب والقش. سدس 12 سجل اعلى القيم فى وزن الالف حبة وعدد السنابل فى المتر المربع. وسجل ايضا اعلى القيم لعدد السنابل/ متر مربع، وزن الالف حبة مع معاملة Ir 4. سجل الصنف مصر 1 اعلى محصول للحبوب، محصول القش، عدد حبوب /سنبلة مقارنة بكل من سخا 93 وسدس 12. نقص رية واحدة عن اربعه ريات تؤدى إلى نقص فى المحصول لكل من سدس 12، مصر 1 وسخا 93 بمعدل 6، 10 و11% على التوالى. يفضل زراعة الصنف سدس 12 فى شمال الدلتا عند نقص عدد الريات. واوضحت الدراسة ايضا انة يجب الرى فى طوري التفريع و قبل التزهير حيث ان الحرمان فى تلك الاطوار يؤدى إلى نقص فى المحصول بما قيمته حوالي 24%.