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Evaluation of some Bread Wheat Cultivars under Irrigation Intervals 1: Grain Yield, Its Attributes and Water Use Efficiency

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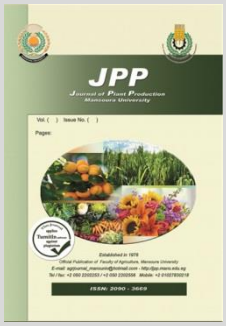

ABSTRACT

This study was performed at El-Gemmeiza Agricultural Research Station (ARC), El- Gharbia Governorate, Egypt, during 2019/2020 and 2020/2021 growing seasons to evaluate effects of three irrigation intervals on grain yield and yield components and water use efficiency of ten wheat cultivars. Four replications of a split-plot design were carried out, the main plots were included three irrigation intervals *i.e.*, irrigation every 20, 30 and 40 days and the ten bread wheat cultivars *i.e.*, Giza171, Sakha 95, Sids14, Misr 3, Giza 168, Misr 2, Gemmeiza 11, Sakha 94, Shandweel 1 and Gemmeiza 12 were placed in sub-plots. Irrigation intervals every 20 days recorded the highest significant values of all the studied characters except for grain protein percentage and water use efficiency that recorded highest values by irrigation intervals every 40 days in the two growing seasons. Misr 3 cultivar recorded the highest 1000-grain weight, number of spikes/m^2, grain weight/spike, grain and biological yields/fad in the two seasons. While, Gemmeiza 11 generated the tallest spike and the highest protein content in the grain during the two seasons. Irrigation Misr 3 every 20 days produced the highest spike/m^2, biological yields and grain yield per fad in the second season. While irrigating Gemmeiza 11 and Shandweel 1 every 20 days resulted in the best water consumption use in the two seasons. Finally, a positive correlation and significant relationships were detected between grain yield/fad and all yield attributes. It could be concluded that growing Misr 3 cultivar with irrigation every 20 days can achieve high grain yield and water use efficiency under middle delta zone conditions.

Keywords: Bread wheat, cultivars, irrigation intervals, yield, water use efficiency.

INTRODUCTION

Wheat is the strategic crop all over the world. One of the oldest and most significant cereal crops in Egypt, wheat is regarded as the primary source of animal straw yield as well as the first food grain for all communities. But on a long term through the last decades the cultivated area suffered from high competition with the other winter crops, especially berseem clover (Hamada *et al.*, 2022). Raising wheat productivity to meet the human need and declining the gap between local consumption and production could be approached, through several ways either horizontal or vertical, cultivate the newly reclaimed areas with high yielding, salinity and drought tolerant cultivars using precise irrigation systems and modern sowing methods, combining with proper cultural practices.

In arid and semi-arid climates, the most significant practice that limits wheat output is the need for water. Thus, boosting wheat production while conserving water and improving water usage efficiency can be achieved through optimizing irrigation, which involves applying irrigation water in a timely and quantitative manner. It is commonly recognized that the availability of soil moisture throughout the growing season affects crop productivity. Where water is the primary factor limiting wheat output, optimizing water usage efficiency will be critical. Water scarcity in irrigated agriculture, inadequate irrigation, and infrequent rainfall all contribute to water deficit stress (Ouda *et al.*, 2020). Al-Zahy *et al.* (2020) reported that increasing irrigation intervals expose wheat plants to drought stress which can decrease grains spike weight, number of spikes/m^2, 1000-grain weight, straw yield, grain yield, and protein %. Efforts are hardly exerted to enhance wheat productivity per unit area through creating new, highly productive cultivars that consume low water. (El-Gabry and Hashem, 2018). The water deficit stress for wheat has been reported to reduce the number of days to maturity, grain and biological yield and its attributes (Thanaa *et al.*, 2019; El-Hamid *et al.*, 2020 and Henian *et al.*, 2020).

Extending irrigation intervals from 6 to 9 or 12 days has been suggested to decrease the vegetative traits and yield attributes, such as weight of 1000 grains, number of grains per spike and grain yield per fed besides increasing the grain protein content and water use efficiency. (Ali *et al.*, 2022).

According to Hamada *et al.* (2022), in order to achieve maximum productivity, commercial wheat cultivars in the Egyptian agricultural system should be redistributed and cultivated under suitable conditions because they differ in yield production, quality, and response to biotic and abiotic stresses.

So, in Egypt, the national target aimed to raise the productivity by creating new cultivars with low water consumption.

MATERIALS AND METHODS

This study was performed at El-Gemmeiza Agricultural Research Station (ARC), El- Gharbia Governorate, Egypt, during 2019/2020 and 2020/2021

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growing seasons to evaluate the effect of three irrigation intervals on yield and yield attributes and water use efficiency of ten bread wheat cultivars. A split- plot design with four replications was used. The main plots were divided into three irrigation intervals *i.e.*, irrigation every 20, 30 and 40 days and the ten bread wheat cultivars *i.e.*,Giza171, Sakha 95, Giza 168, Sids14, Misr 3, Misr 2, Sakha 94, Gemmeiza 11, Shandweel 1 and Gemmeiza 12 were placed in sub-plots.

Name and pedigree of the studied bread wheat cultivars are shown in Table 1. Table 2 displays the calculated amounts of irrigated and accumulated water applied in different irrigation treatments. Table 3 provides the meteorological data for the winter seasons of 2019/2020 and 2020/2021.The plot area was 8.4 m^2 *i.e.* 12 rows, 3.5 m^2 in length and 20 cm apart. Maize was the preceding summer crop in the two growing seasons. Sowing date was on17th November in the first season and on 20th November in the second one. The drilling was the used sowing method. 8.1 and 7.9 pH values were found in the clay-containing soil in both seasons.

All other cultural techniques were carried out in compliance with the region's conventional planting guidelines for wheat. The harvest of the crop was during the first two weeks of May 2020 and 2021.

Table 1. Name and pedigree of the studied bread wheat cultivars.

No.	Name	Pedigree
1	Giza171	SAKHA93/GEMMEIZA9
2	Sakha 95	PASTOR//SITE/MO/3/CHEN/AEGILOPS/ SQUARROSA(TAUS)//BCN/4/WBLL1
3	Giza 168	MIL/BUC//SERI
4	Sids14	BOW"S"/VEE"S"//BOW"S"/TSI/3/BANI SEWEF1
5	Misr 3	ROHF07*2/KIRITI
6	Misr 2	SKAUZ/BAV92
7	Sakha 94	OPATA / RAYON // KAUZ
8	Gemmeiza11	BOW"S"/ KVS"S"// 7C/ SERI 82/3/ GIZA 168/ SAKHA 61
9	Shandweel1	SITE/MO/4/NAC/TH.AC//3*PVN/3/MIRL O/BUC
10	Gemmeiza12	OTUS/3/SARA/THB//VEE

Table 2. Amount of irrigation water, total rainfall and seasonal water applied (m^3/fed) under different irrigation treatment during the two - growing seasons, 2019/20 and 2020/21.

Irrigation treatment	Seasons					
	2019/20			2020/21		
	I_1(20 days)	I_2(30 days)	I_3(40 days)	I_1(20 days)	I(30 days)	I_3(40 days)
Irrigation water (m^3/fed)	1865.2	1639.6	762.4	1830.6	1551.9	635.3
Total rainfall (m^3/fed)		434.17			312.59	
Seasonal water applied (m^3/fed)	2299.37	2073.77	1196.57	2143.19	1864.49	947.89

Studied characters

The following information on grain yield and its characteristics was noted at harvest: number of spikes/ m-2 (NSm-2), number of grains/spike-1 (NGS-1), grains weight/spike (g), 1000-kernel weight (1000 KW; g), spike length (SL, cm), straw yield (SY, Ton fed-1), biological yield (BY, Ton fed-1), grain yield (GY, Ardab fed-1), harvest index (HI,%) and grain protein content (%).

The improved Kjeldahl method of A.O.A.C. (1990) was used to determine the amount of nitrogen. It was modified by distilling ammonia into saturated form using standard hydrochloric acid. The total nitrogen in the grain was multiplied by 6.25 to determine the protein percentage (protein percentage = grain N % × 6.25).

Table 3. Monthly mean of air temperature *(C^o)*, mean relative humidity (RH %) and rainfall (mm/month) in winter seasons 2019/20 and 2020/21 at El - Gemmeiza site.

Month	Temperature (Co)				(RH %)		Rainfall (mm)	
	Max.	Min.	Max.	Min.	2019 / 20	2020 / 21	2019 / 20	2020 / 21
	2019 / 20		2020 / 21					
Nov.	27.2	14.3	29.1	14.6	63.3	62.4	0.13	-
Dec.	25.5	14.0	24.9	13.7	66.5	68.0	0.82	1.50
Jan.	20.6	13.7	18.3	13.3	78.9	80.1	1.29	0.41
Feb.	18.4	12.5	18.7	12.8	75.7	78.3	1.74	0.25
Mar.	22.7	13.3	23.1	14.0	71.4	70.2	0.19	0.34
Apr.	29.6	18.6	31.0	19.1	61.1	59.6	-	0.09

Max = maximum temperature, Min = minimum temperature

Measurements of water:

1- Water counter was used to measure the quantity of irrigation water applied in millimeters per feed for each treatment. (Table 2).

2 - The weight of grain yield in kilograms of water applied (m^3) during the growing seasons was used to express the water use efficiency (kg/m^{-3}). It was calculated according to Doornbos and Pruit (1977) as follows:

WUE=Grain yield (kg/fed) / Total applied water (m^3/fed).

3- Water consumptive use (mm/fed):It was determined gravimetrically by taking soil samples before and after irrigation (Israelson and Hansen,1962) according to the following equation:

$$CU= \theta_2-\theta_1\times Bd \times 60/100$$

Where θ_2 = soil moisture at 48 hrs.after irrigation, θ_1= soil moisture content just before irrigation and Bd=Bulk density of the soil layer g/cm^{-3}.

Correlation coefficients analysis: was performed according to Kearsey and Pooni (1996) between grain yield and its attributes.

Statistical analysis:

Analysis of variance (ANOVA), as described by Gomez and Gomez (1984), was used to examine the

collected data. The probability level of (0.05) was used as the least significant difference (LSD).

RESULTS AND DISCUSSION

Irrigation intervals effects:

The data in Tables (4, 5,6 and 7) showed that the evaluated irrigation intervals in both seasons had a significant impact on every wheat trait that was studied. Whereas, irrigation intervals every 20 days (I1) increased number of spikes m-2 by 15.84% and 16.88%, number of grains spike-1 by 31.25% and 25.53%, grain weigh/ spike by 44.75% and 41.615%, 1000-kernel weight by 53.34% and 49.18%, spike length (cm) by 20.63% and 28.69%, straw yield (ton/ fed) by 54% and 136.6%, biological yield (ton/fed) by 56.44% and 94.16%, grain yield (Ard/ fed) by 61.36% and 45.52% and water consumption use (CU) (mm/fed-1) by 41.12% and 41.75%as compared to I3(40 days) in both seasons, respectively. Also, harvest index (%), grain protein (%) by 13.67% and 19.81% and water use efficiency (kg/m-3) by 49.34% and 64.88% significantly increased by increasing irrigation interval up to 40 days by 2.98% and 40.85% in both seasons.

A 20-day irrigation interval can result in an adequate supply of water in root zone, particularly during plant critical stages. This can enhance and improve the rate and net of photosynthesis, as well as cell division and elongation, leading to increased yield attributes. Additionally, the shorter irrigation intervals can indirectly aid in the transfer of carbohydrates from source to sink. Additionally, adequate irrigation water may lengthen grain filling period and aid in the plant's absorption of necessary nutrients and water. (El-Hendawy, 2016). On the other hand, the production of fresh and dry matter is thought to be reduced by drought stress (Gora *et al*., 2022), which in turn can reduce spike length (Kanwal *et al*., 2020), the yield of grains (El-Nagar and EL-Gohary, 2022), 1000-grain weight and weight of grains spike (Al-Zahy *et al*., 2020 and Kotb *et al*., 2021), and increase WUE. According to Taha *et al*., 2017, sufficient irrigation with 180 mm of applied water enhanced grain yield but lowered WUE. In contrast, 60 mm of applied water at elongation provided an increase in WUE and a relatively high grain yield. Also, as a response to short irrigation intervals, the increased grain yield was related to the enhancement of agronomic traits (Aissaoui and Fenni, 2021). Shorter watering intervals were found by several researchers to enhance the wheat crop's growth and yield characters (Shah *et al*., 2021; Ragheb *et al*., 2018; Ahmed and Mustafa, 2018; Walsh *et al*., 2020; and Munsif *et al*., 2022). For increasing irrigation duration, all investigated attributes significantly decreased with the exception of wheat plant protein content (El-Saadony *et al*., 2021).

Data in Tables 6 and 7 showed that irrigation every 20 days was the best interval that recorded an increase in water consumption use (WCU) (mm/fed-1) by 41.12% and 41.75% as compared to I3 (40 days) in both seasons, respectively. Meanwhile, harvest index (%), Grain protein content was significantly increased by 13.67% and 19.81% and WUE (kg/m-3) by 49.34% and 64.88% with increasing the interval up to 40 days by 2.98% and 40.85% in the two seasons respectively.

Wheat cultivars performance:

Data in Tables 4,5,6 and 7 showed that the tested cultivars were significantly varied in all examined traits, except harvest index trait. Whereas, Misr 3 wheat cultivar recorded the highest values in 1000-kernel (g), weight number of spikes m^{-2}, grain yield (Ard. fed^{-1}), grain weight / spike (g), straw yield (ton. fed^{-1}) and biological yield (ton.fed^{-1}). Meanwhile, Gemmeiza 11cultivar had the tallest spikes among the tested wheat cultivars. Interestingly, Sakha 95 cultivar produced the highest number of grains $spike^{-1}$ and Shandweel 1 was the best cultivar in harvest index in the two growing seasons. Similar findings were found by El-kalla *et al*. (2010), Moustafa (2013), Abdelkhalek *et al*. (2015) and El-Ashmouny *et al*. (2016).

Regarding data in Table 7, the tested wheat cultivars were differed in respect to protein content (%), WUE and Water consumptive use (CU). Hence, Gemmeiza 11 wheat cultivar recorded the highest grain protein content (%) in both seasons. There were significant variations in WUE of the wheat genotypes during both seasons. The values ranged from 7.08to 10.28and7.15 to 10.94 kg/m^{-3}, in both seasons. Whereas, the highest WUE was obtained by Misr 3 wheat cultivar in both seasons. This could be because it's resistance to abiotic stress as temperature and drought maintaining higher productivity in comparison to other cultivars. For Shandweel 1, it had the lowest values that can show its low water sensitivity restricting its yield. While, the highest water consumption use was recorded by Gemmeiza 11 in the first season and by Shandweel wheat cultivars in the second one. According to Waraich *et al*. (2010), WUE shows how well a crop grows in any kind of environment. These outcomes agree with Allahverdiyev's (2015) findings. Similar results were delineated by Gab Alla (2007) and Singh *et al*. (2018).

Table 4. Effects of irrigation intervals, 10 bread wheat cultivars and their interaction on number of spikes/m^{-2}, number of grains /$spike^{-1}$ and grain weight/spike (g) in 2019/20 and 2020/21 seasons.

Characters	Number of spikes / m^{-2}		Number of grains /$spike^{-1}$		Grain weight/ spike (g)	
Factor	1st season	2nd season	1st season	2nd season	1st season	2nd season
Irrigation (I)						
I_1(20 days)	468	450	63	59	4.27	4.05
I_2(30 days)	435	430	56	54	3.52	3.40
I_3(40 days)	404	385	48	47	2.95	2.86
F-test	**	**	**	**	**	**
LSD 0.05	7.6	9.1	2.2	2.2	0.18	0.25
Wheat cultivars (V)						
Giza171	455	450	58	56	4.27	3.77
Sakha 95	457	453	64	61	4.45	4.23
Giza 168	438	435	61	58	3.90	4.08
Sids14	420	406	53	51	2.72	2.41
Misr 3	462	458	62	60	4.83	4.76
Misr 2	446	441	59	58	4.06	3.92
Sakha 94	424	416	48	45	3.26	3.52
Gemmeiza 11	413	391	51	49	2.47	2.65
Shandweel 1	409	341	45	42	2.00	1.93
Gemmeiza 12	434	429	55	54	3.80	3.09
F-test	**	**	**	**	**	**
LSD 0.05	11.8	14.9	3.2	3.1	0.31	0.38
Interaction						
I×V	NS	**	NS	NS	*	NS

Table 5. Effects of irrigation intervals, 10 bread wheat cultivars and their interaction on 1000-kernel weight (g), spike length (cm) and straw yield (T. fed^{-1}) in 2019/20 and 2020/21 seasons.

Characters	1000-kernel weight (g)		Spike length (cm)		Straw yield (T. fed^{-1})	
Factor	1st season	2nd season	1st season	2nd season	1st season	2nd season
Irrigation (I)						
I_1(20 days)	54.10	49.84	12.92	13.50	6.93	6.27
I_2(30 days)	41.14	40.74	11.77	11.63	6.15	4.95
I_3(40 days)	35.28	33.41	10.71	10.49	4.50	2.65
F-test	**	**	**	**	**	**
LSD 0.05	1.08	0.99	0.20	0.16	0.41	0.31
Wheat cultivars (V)						
Giza171	48.24	45.87	12.15	12.06	7.06	5.41
Sakha 95	51.53	48.84	11.26	11.56	7.71	5.94
Giza 168	43.55	41.81	11.69	11.90	5.98	4.88
Sids14	37.46	36.40	10.80	11.13	4.47	3.66
Misr 3	55.77	51.81	10.35	10.83	8.62	6.67
Misr 2	45.97	43.92	9.56	10.08	6.40	5.09
Sakha 94	41.09	39.00	10.93	11.26	5.31	4.07
Gemmeiza 11	34.96	33.26	14.13	14.35	4.30	3.33
Shandweel 1	33.64	31.58	13.35	12.61	3.03	2.59
Gemmeiza 12	42.86	40.82	13.77	12.95	5.74	4.59
F-test	**	**	**	**	**	**
LSD 0.05	3.44	3.40	0.93	0.90	0.81	0.76
Interaction						
I×V	NS	NS	NS	NS	NS	NS

Table 6. Effects of irrigation intervals, 10 bread wheat cultivars and their interaction on biological yield (ton.fed^{-1}), grain yield (Ard. fed^{-1}) and harvest index (%) in 2019/20 and 2020/21 seasons.

Characters	Biological yield (ton.fed^{-1})		Grain yield (Ard. fed^{-1})		Harvest index (%)	
Factor	1st season	2nd season	1st season	2nd season	1st season	2nd season
Irrigation (I)						
I_1(20 days)	10.81	9.65	25.85	22.57	36.21	35.69
I_2(30 days)	9.60	8.13	23.02	21.21	35.90	39.08
I_3(40 days)	6.91	4.97	16.02	15.51	37.29	50.54
F-test	**	**	**	**	NS	**
LSD 0.05	0.39	0.47	1.69	1.15	-	3.75
Wheat cultivars (V)						
Giza171	10.97	8.93	26.06	23.54	35.69	40.92
Sakha 95	11.75	9.58	26.98	24.26	34.44	38.73
Giza 168	9.55	8.08	23.80	21.38	37.64	40.68
Sids14	6.94	5.97	16.46	15.40	36.63	42.37
Misr 3	12.84	10.43	28.13	25.07	32.93	36.86
Misr 2	10.09	8.41	24.63	22.14	36.37	40.26
Sakha 94	8.37	6.84	20.39	18.47	36.99	42.66
Gemmeiza 11	6.51	5.46	14.72	14.21	36.50	43.60
Shandweel 1	4.87	4.47	12.25	12.61	40.02	48.56
Gemmeiza 12	9.17	7.67	22.88	20.57	37.46	43.07
F-test	**	**	**	**	NS	NS
LSD 0.05	0.76	0.71	1.90	1.62	-	-
Interaction						
I×V	NS	*	NS	**	NS	*

Table7. Effects of irrigation intervals, 10 bread wheat cultivars and their interaction on grain protein (%), water use efficiency (kg/m^{-3}) and water consumptive use(mm/fed^{-1}) in 2019/20 and 2020/21 seasons.

Characters	Grain protein (%)		WUE (kg/m^{-3})		WCU (mm/fed^{-1})	
Factor	1st season	2nd season	1st season	2nd season	1st season	2nd season
Irrigation (I)						
I_1(20 days)	11.05	10.75	6.87	7.29	509.75	520.48
I_2(30 days)	12.16	11.83	8.32	7.44	454.98	438.65
I_3(40 days)	12.56	12.88	10.26	12.02	361.22	367.18
F-test	**	**	**	**	**	**
LSD 0.05	0.56	0.59	0.21	0.19	8.41	17.96
Wheat cultivars (V)						
Giza171	11.75	10.72	9.09	10.29	348.38	309.87
Sakha 95	11.17	11.33	9.62	9.83	324.38	347.05
Giza 168	12.83	12.25	8.23	7.75	570.23	420.57
Sids14	13.02	12.98	7.80	8.42	512.37	509.04
Misr 3	12.22	11.86	10.28	10.94	379.50	377.50
Misr 2	10.56	11.04	8.74	8.85	299.87	337.16
Sakha 94	10.13	10.46	7.47	7.64	489.36	489.47
Gemmeiza 11	13.23	13.13	8.13	8.54	607.94	558.00
Shandweel 1	12.31	12.36	7.08	7.15	422.46	605.72
Gemmeiza 12	12.04	12.05	8.42	9.56	465.35	466.68
F-test	**	**	**	**	**	**
LSD 0.05	0.90	0.91	0.96	0.98	21.94	23.70
Interaction						
I×V	NS	NS	NS	NS	**	**

Interaction between the examined traits

Data in Table 8 indicated that the interaction between water treatments and cultivars was highly significant delineating the different response of wheat cultivars to water intervals. In this concern, the combination of Misr3 and the irrigation interval every 20 days produced the highest number of spikes/m^2, biological yield (T.fed^{-1}) and grain yield (Ard.fed^{-1}) in the second season.

Data presented in Table 9 delineated that Shandweel 1, in the second season, recorded the highest harvest index (%) when irrigated every 40 day. The highest WCU (mm/fed^{-1}) was obtained by Misr3 with irrigation every 40 days in both seasons.

Correlation coefficients analysis:

The correlation coefficient was used to assess how much each character in each setting was associated with yield as well as with other characters. According to table 10, number of grains/spike^1, number of spikes/m^2, 1000-kernel weight (g), grain weight/spike (g), biological yield (ton./fed^{-1}), spike length (cm) and straw yield (ton.fed^{-1}) had the highest influence on grain yield/fed. Another worthy correlation is that between spike length (cm) and each of number of spikes/m^2, number of grains/spike^1,1000-kernel weight(g),grain weight/spike (g), biological yield (ton.fed^{-1}) and straw yield (ton.fed^{-1}).

Table 8. Effects of interactions between irrigation intervals and cultivars on number of spikes/m^{-2}, biological yield (T.fed^{-1}) and grain yield (Ard. fed^{-1}) in 2020/21 season.

Characters	Number of spikes/m^2			Biological yield (T.fed^{-1})			Grain yield (Ard.fed^{-1})		
Wheat cultivars	Irrigation intervals (I)			Irrigation intervals (I)			Irrigation intervals (I)		
(V)	2020/21			2020/21			2020/21		
	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3
Giza171	482	447	421	11.35	9.17	6.28	26.31	24.88	19.42
Sakha 95	483	451	424	12.00	9.39	7.35	27.02	25.50	20.25
Giza 168	465	438	400	10.42	8.65	5.18	24.58	24.14	15.42
Sids14	447	420	351	8.13	6.31	3.45	17.73	15.74	12.73
Misr 3	489	458	427	12.69	10.85	7.77	27.35	26.67	21.20
Misr 2	475	442	406	10.59	8.93	5.70	25.82	24.49	16.10
Sakha 94	449	423	375	8.98	7.53	4.00	21.66	20.70	13.04
Gemmeiza 11	431	405	338	6.85	6.11	3.42	16.10	14.09	12.45
Shandweel 1	318	388	318	5.16	6.02	2.25	14.62	12.94	10.26
Gemmeiza 12	464	433	389	10.35	8.35	4.31	24.52	22.96	14.24
LSD 0.05	26.90			1.21			2.78		

Table 9. Effect of irrigation intervals × cultivars interactions on harvest index (%) and water consumptive use(mm/fed^{-1}).

Characters	Harvest index (%)			Water consumptive use (mm/fed^{-1})					
Wheat cultivars (V)	Irrigation intervals (I)			Irrigation intervals (I)					
	2020/21			2019/20			2020/21		
	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3
Giza171	35.08	40.99	46.69	390.49	354.16	300.49	396.83	333.83	310.49
Sakha 95	33.91	40.83	41.46	386.10	339.56	247.49	394.43	332.90	284.16
Giza 168	35.42	41.93	44.69	633.17	595.92	481.59	486.25	421.88	353.58
Sids14	32.49	37.86	43.15	612.59	524.03	400.50	616.92	509.69	400.50
Misr 3	32.41	37.08	41.08	445.49	370.10	322.90	385.90	308.83	234.88
Misr 2	37.08	41.22	42.49	359.23	318.49	221.88	459.49	350.10	322.90
Sakha 94	36.14	42.17	49.52	561.88	516.50	389.69	571.88	506.84	389.69
Gemmeiza 11	35.63	34.83	46.71	672.61	627.27	523.94	643.17	549.25	481.59
Shandweel 1	42.89	32.61	49.66	478.58	435.22	353.58	679.27	613.94	523.94
Gemmeiza 12	35.90	41.31	48.02	527.36	468.58	370.10	570.69	459.25	370.10
LSD 0.05		12.50			36.51			41.00	

Table 10. Correlations between grain yield and other related traits in wheat cultivars (over treatments and seasons).

Characters	1	2	3	4	5	6	7	8
1.Grain yield (Ard.fed).	1.000							
2. Number of spikes/m^2.	0.879**	1.000						
3. Number of grains /spike.	0.826**	0.859**	1.000					
4. 1000- kernel weight (g).	0.983**	0.872**	0.828**	1.000				
5. Grain weight/spike (g).	0.902**	0.664**	0.813**	0.857**	1.000			
6. Spike length (cm)	0.844**	0.120^{ns}	0.175^{ns}	0.163^{ns}	-0.028^{ns}	1.000		
7. Biological yield (ton/ fed).	0.921**	0.925**	0.861**	0.881**	0.505*	0.086^{ns}	1.000	
8. Straw yield (ton/fed).	0.836**	0.797**	0.832**	0.752**	0.660**	0.117^{ns}	0.632**	1.000

In addition, a high positive significant relationship was found between the number of grains/spike, 1000-kernelweight (g), grain weight/spike (g), biological yield (ton. fed^{-1}) and straw yield (ton.fed^{-1}), as well as, between 1000-kernel weight(g) and each of grain weight/spike (g), biological yield (ton.fed^{-1}) and straw yield (ton.fed^{-1}). The findings made it abundantly evident that there was a significant positive association between grain weight/spike (g) and both straw yield (ton.fed^{-1}) and biological yield (ton.fed^{-1}). Additionally, spike length (cm) showed a strong positive correlation with both straw yield (ton.fed^{-1}) and biological yield (ton.fed^{-1}).The highest positive correlation of 0.98 was appeared between 1000-kernel weight (g) and grain yield/fed.whereas the lowest positive correlation of 0.11was expressed between spike length (cm) and straw yield (ton.fed^{-1}),while lowest negative correlation of -0.02 was appeared between grain weight/spike (g) and spike length (cm). These results are in accordance with Hama *et al.* (2016).

CONCLUSION

Under the conditions of El-Gemmeiza region in the old land in middle delta, Misr 3 with irrigation interval of 20 days could be recommended for higher grain yield per water and soil unit in the terms of higher water use efficiency. Planting Misr 2 and Giza171 to save irrigation water when it is not available at the end of irrigation canals or in areas where water is scarce.

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تقييم بعض أصناف قمح الخبز تحت تأثير فترات الرى 1: المحصول ومكوناته وكفاءة إستخدام مياه الرى

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الملخص

تم إجراء تجربة حقلية خلال موسمي الزراعة 2019 / 2020، 2021/2020 في المزرعة البحثية بمحطة البحوث الزراعية بالجميزة، محافظة الغربية، مركز البحوث الزراعية (ARC) ، الجيزة ,مصر لدراسة تأثير ثلاثة معاملات ري و هي الري كل (20-30-40) يوم على المحصول و مكوناته و كفاءة الاستخدام المائي لعشرة أصناف من القمح (جيزة 171- سخا95- جيزة 168- سدس 14- مصر3- مصر2- سخا 94- جميزة 11- شندويل 1- جميزة 12). وتم تنفيذ التجربة فى تصميم القطع المنشقة في أربع مكررات. أوضحت النتائج أن ري أصناف القمح كل 20 يوم سجل أعلى قيم معنوية في كل الصفات المدروسة ماعدا نسبة البروتين في الحبوب وكفاءة إستخدام المياه اللذان حققا أعلي نتائج عند الري كل 40 يوم في كلا الموسمين . كما سجل الصنف مصر3 أعلى قيم معنوية في وزن 1000 حبة و عدد السنابل/ م^2 و وزن حبوب السنبلة ومحصول الحبوب والمحصول البيولوجي للفدان في كلا الموسمين. بينما سجل الصنف جميزة 11 أعلى طول للسنبلة و أعلى نسبة بروتين في الحبوب.وأعطي رى صنف القمح مصر 3 كل 20 يوم أعلى قيم معنوية من عدد السنابل/ م^2 و أعلى محصول الحبوب و المحصول البيولوجي للفدان في الموسم الثاني. كما تحققت أعلى قيم معنوية من معدل الاستهلاك المائي عند ري أصناف جميزة 11 و شندويل 1 كل 20 يوم في كلا الموسمين. كما أشارت النتائج الى أن معامل الارتباط كان موجبا بين محصول الحبوب وكل مكوناته.ولذلك يوصي بزراعة الصنف مصر 3 مع الرى كل 20 يوم للحصول علي أعلي محصول وأعلي كفاءة في إستخدام مياه الري وذلك تحت ظروف منطقة وسط الدلتا.