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Effect of planting methods and irrigation intervals on productivity of some bread wheat cultivars

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Abstract

A field experiment was carried out at Experimental Farm, in Al. kalahyn, Al. Hajer village, Qeft, Qena governorate, Egypt during 2017/2018 and 2018/2019 seasons, to evaluate of three planting methods (Drilling, broadcasting and furrows) and three irrigation intervals (21 , 28 and 35 days) on productivity of three wheat cultivars (Sids 12 –Misr 2 and Giza 168). The results showed that exposing wheat plants to drought stress by increasing irrigation intervals significantly decrease (1000-grain weight, grains spike weight, number of spikes/m^2, grain yield (ardab/fed) (argab = 150 Kg, fed= feddan= 4200^2 m² = 0.420 hectares = 1.037 acres), straw yield (ton/fed) and protein %). Irrigation intervals showed highly significant difference in for all characters studies. The highest value resulted from application irrigation intervals at 21 day compare with the other irrigation intervals. Planting methods significantly affected by all a previous characters. The highest value for all studies characters resulted from using drilling method. There were highly significant differences among wheat cultivars for all characters under study. The wheat cultivar sids-12 gave of the highest values of all traits compared to the other wheat cultivars used in both seasons.

Keywords: wheat, irrigation intervals, planting methods, cultivar, yield.

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1. Introduction

Wheat (*Triticum aestivum* L.) is one of the leading cereals in the world. It belongs to the family Graminede, wheat is considered one of the most vital cereal crops not only in Egypt, but also in the whole world. As it is used for nourishment and food it supplies 20% calories and 21% of protein of the food for world people (Braune *et al*., 2010). In Egypt, wheat is the main winter cereal crop and is widely distributed all over the country. The cultivated area is 3. 36 million feddan with an average grain yield of 18.42 ardab/fed (argab = 150 Kg, fed= feddan= 42002 m^2 = 0.420 hectares = 1.037 acres), with the actual local production is about 9.63 million tons and consumption is 16 million tons (FAO, 2016). From the aforementioned data the local production of wheat is not sufficient to supply the maul demand of the increasing population. This caused gap between production and consumption approximate 6 million ton that imported annually to meet the needs of local markets. So, increasing wheat production is most important possibility for reducing the gap and reaching to self sufficiency of wheat production. In this regard, researchers make efforts to increase the productivity per unit area of wheat by devising new cultivars of high productivity and low water consumption (El-Gabry and Hashem, 2018). Irrigation could be considered the limiting factor affecting crop production and agricultural expansion. In Egypt, especially in Nile Valley and Delta region, where farmers use extra water to irrigate their farms. So, irrigation optimization, i.e. applying the irrigation water timely and quantitatively will increase wheat yield and save considerable amount of water. Many researchers proved the importance of irrigation treatment to maximize wheat productivity. Sharsher and El-sayed (2000) showed that plant height, number of spike/m^2, grain yield, straw yield, number of grain /spike and 1000-grain weight were significantly affected by water stress. Also, Moagedi *et al.* (2010) reported that plant height, number of grain/spike, 1000-grain weight, harvest index and grain yield were significantly affected by water defecate. Moreover, planting method is one of the factors affecting on the yield of wheat. So, standard planting method of wheat has a beneficial role in affecting wheat plants distribution in the field as well as water and nutrients use efficiencies for grown plants and subsequent optimum yields. Planting method in wheat like other crops responds greatly to various agro management practices, and it affected to yield and its characters (Attia *et al.*, 2013). The objectives of this study were: (1) Saving the amount of water by determine the number of times the irrigation needed to produce the best crop from grain yield. (2) Selection the best planting methods that gave the highest grain yield and saving the amount of seed.

2. Materials and methods

Two field experiments were carried out at Experimental Farm, in Al. kalahyn, Al. Hajer village, Qeft center, Qena governorate, Egypt during seasons of 2017/2018 and 2018/2019, to study the

evaluate of planting methods and number of irrigation times on productivity of three bread wheat cultivars. Studied factors**:** Three wheat varieties (Sids 12, Misr 2 and Giza 168) and three irrigation intervals (21day, 28 day and 35 day) and three planting methods (Drilling, furrows and broadcast). The performed experiment was designed as randomized complete block design with split- split plot arrangement of treatments with three replications. Irrigation intervals were assigned to the main plot, plant method was distributed randomly in the sub plots and wheat varieties were located in the sub- sub plots. The experimental unit area was 3.5 m length x 3.0 m width (10.5 m^2). In this study, sowing date was on 17 th and 20 th November in the first and second seasons, respectively (Table 1-3). As harvested in 5 th and 25 th April in the first and second seasons, respectively. The preceding summer crop was the earth boor and the second season was sorghum in both seasons. All other practices were uniformly applied as recommended for wheat production in the region.

Table (1): Mechanical, chemical and physical properties of experimental site before the cultivation during 2017/2018 and 2018/2019 seasons, according to the methods described by Jackson (1975).

Season 2017/2018										
EC	PH	$CaCo_3$ (%)	Soluble Cation (meg/liter)				Soluble anions (meg/liter)			
			Ca	Mg	Na	K	Co_3	HCo_3	Cl	So_4
0.98	7.3	10.3	1.2	3.1	0.35	1.07	0.45	0.2	1.43	4.1
Macro nutrients (ppm)					Micro nutrients (ppm)					
N		P	K		Fe		Zn	Mn	Cu	
20		4.8	292		5.57		0.20	5.46	0.29	
Organic matter (%)					Soil texture					
2.2					Sand%		Clay (%)			
					12.12		87.88			
Season 2018/2019										
EC	PH	$CaCo_3$ (%)	Soluble Cation (meg/liter)				Soluble anions (meg/liter)			
			Ca	Mg	Na	K	Co_3	HCo_3	Cl	So4
1.06	8	13.8	1.4	3.4	0.39	1.10	0.47	0.2	1.47	4.6
Macro nutrients (ppm)					Micro nutrients (ppm)					
N		P	K		Fe		Zn	Mn	Cu	
24		5.3	298.6		6.67		0.31	5.88	0.33	
Organic matter (%)					Soil texture					
3.8					Sand%		Clay%			
					10.54		89.46			

Table (2): Results of the moisture content of the soil.

Season	Moisture content (%)	
	2017/2018	2018/2019
21 Day	83.4	86.5
28 Day	79.1	81.2
35 Day	70.9	73.6

Humidity was estimated at the regional laboratory in the agricultural Department in Qena, Egypt.

Table (3): Mean of temperature data during two growing seasons.

Months	Mean of temperature (°C)			
	2017/2018		2018/2019	
	Max	Min	Max	Min
November 15-30	28	13	29	13
December 1-15	26	11	23	10
December 16-31	27	12	22	8
January 1-15	22	8	19	6
January 16-31	23	7	22	7
February 1-15	27	10	24	9
February 16-28	29	12	25	11
March 1-15	33	15	26	10
March 16-31	37	18	29	13
April 1-15	37	18	32	14
April 16-30	36	19	33	16

Source: Agricultural Meteorology Cell, Agricultural Directorate in Qena. https://ar.climate-data.org/location/3676. https://www.accuweather.com.

At harvest, ten plants were chosen randomly from each plot to measure the following characters:

1. 1000-grain weight (g): 1000 tablets are taken and weighed.

2. Grains weight /spike (g).

3. Number of spikes/m^2: (1m x 1m) m^2 Number of spikes in one square meter of each plot.

4. Grain yield (ardab/fed) (argab = 150 Kg, fed= feddan= 42002 m^2 = 0.420 hectares = 1.037 acres): The grain of each plot (10.5 m^2) was weighted and the mean grain yield (ardab/fed) was calculated.

5. Straw yield (ton/fed): determined by weighing the biological yield in each plot then substrating the grain weight for the whole plants, results were expressed as ton/fed.

6. Protein percentage (%) in grain : Nitrogen determination was carried out by the improved Kieldhal method of A.O.A.C. (1980) which modified by distilling the ammonia into saturated boric solution and titration was carried out by using standard hydrochloric acid and calculated by using multiplying the total nitrogen in grain x 6.25 (Protein percentage = Grain N % x 6.25).

The recorded data were statistically analyzed in SAS software (SAS version 9.2, SAS Institute, 2008) according to Gomez and Gomez (1984), the least significant differences (LSD) at probability level at 0.05% was calculated according to Petersen (1985) for comparing the differences between treatment means of the studied traits.

3. Results and Discussion

Effect of planting methods and irrigation intervals on productivity of wheat cultivars on yield and yield components of three wheat cultivars in 2017/2018 and 2018/2019 seasons in Tables (4-9). Results showed the effect of wheat cultivars on 1000-grain weight (g) , grains weight / spike (g) , number of spikes/ m^2, grains yield ardab / fed , straw yield (ton/

fed) and protein percentage in grain (%) were significant in both seasons. Sids-12 cultivars was gave the heaviest 1000-grain (g) (45.21 and 52.26), grains weight / spike (g) (3.211 and 4.374), number of spikes/ m^2 (291.1 and 309) , grains yield (ardab / fed) (19.68 and 20.33) , straw yield (ton/ fed) (1.813 and 1.961) and protein percentage in grain (%) (11.31and 11.51) in the first seasons and second seasons, respectively. This result may be due to the interaction between genetic make-up and their environmental condition. Similar findings were found by EL-kalla *et al.* (2010), Badran (2011), Moustafa (2013), Abdelkhalek *et al.* (2015) and El-Ashmouny *et al* (2016).

Table (4): 1000-grain weight (g)of some wheat varieties as affected by irrigation intervals and planting methods in 2017/2018 and 2018/2019 seasons.

Irrigation Intervals	Planting Methods (B)	Season							
		2017/2018				2018/2019			
		Cultivars (V)				Cultivars (V)			
		Sids 12	Giza 168	Misr 2	Mean	Sids 12	Giza 168	Misr 2	Mean
		V_1	V_2	V_3		V_1	V_2	V_3	
I_1	Drill $_{(B1)}$	56.23	52.50	53.47	54.07	62.83	59.57	61.20	61.20
	B. cast $_{(B 2)}$	45.90	37.27	38.57	40.58	54.47	52.33	53.93	53.58
	Furrows $_{(B3)}$	51.27	47.47	49.70	49.48	59.33	55.30	56.87	57.17
Mean		51.13	45.74	47.24	48.04	58.88	55.73	57.33	57.31
I_2	B1	58.50	50.63	53.37	54.17	61.37	57.67	59.10	59.38
	B2	38.63	31.97	36.27	35.62	45.73	42.00	44.77	44.17
	B3	47.23	44.07	46.13	45.81	56.27	51.67	54.63	54.19
Mean		48.12	42.22	45.26	45.20	54.46	50.44	52.83	52.58
I_3	B1	45.20	42.08	43.37	43.55	50.43	47.03	49.47	48.98
	B2	26.17	22.53	24.80	24.50	35.90	28.60	33.70	32.73
	B3	37.80	29.77	34.30	33.96	44.03	37.50	40.97	40.83
Mean		36.39	31.46	34.16	34.00	43.46	37.71	41.38	40.85
Mean for Planting methods	B1	53.31	36.90	45.43	45.21	58.21	45.37	53.21	52.26
	B2	48.40	30.59	40.43	39.81	54.76	40.98	48.16	47.97
	B3	50.07	33.21	43.38	42.22	56.59	44.13	50.82	50.51
Mean		45.21	39.81	42.22		52.26	47.96	50.51	
L.S.D. at 5% for :									
Cultivars (V)		1.29				1.25			
Irrigation (I)		0.6				1.14			
Planting methods (B)		0.63				0.49			
V X I		1.04				1.97			
V X B		-				0.85			
I X B		-				0.85			
V X I X B		1.88				-			

V= Cultivars, B= planting methods, I= irrigation, V_1= variety sids12, B_1= Drill, I_1= 21 day, V_2= variety Giza 168, B_2= B. cast, I_2=28 day, V_3= variety Misr 2, B_3= furrows, I_3= 35 day.

Results showed that the effect of irrigation intervals on all characteristics studied was significant in both seasons. The highest values of all the characteristics studied were found from the 21 days during growing season followed by the 28 days withe significant differences. The lowest values for all characteristics studied were obtained from 35 days in both seasons.

Table (5): Grains weight/spike (g) of some wheat varieties as affected by irrigation intervals and planting methods in 2017/2018 and 2018/2019 seasons.

Irrigation Intervals	Planting Methods (B)	Season							
		2017/2018				2018/2019			
		Cultivars (V)				Cultivars (V)			
		Sids 12	Giza 168	Misr 2	Mean	Sids 12	Giza 168	Misr 2	Mean
		V_1	V_2	V_3		V_1	V_2	V_3	
I_1	Drill $_{(B1)}$	4.067	3.733	3.900	3.900	5.067	3.867	4.667	4.534
	B. cast $_{(B 2)}$	3.133	2.833	3.033	3.000	4.500	3.700	4.067	4.089
	Furrows $_{(B3)}$	3.567	3.333	3.467	3.456	4.533	3.700	4.233	4.155
Mean		3.590	3.300	3.470	3.453	4.700	3.760	4.320	4.260
I_2	B1	3.733	3.300	3.533	3.522	4.800	3.667	4.467	4.311
	B2	2.567	2.400	2.733	2.567	4.167	3.367	3.767	3.767
	B3	3.200	2.900	3.033	3.044	4.333	3.467	3.967	3.922
Mean		3.170	2.870	3.100	3.047	4.430	3.500	4.070	4.000
I_3	B1	3.600	2.967	3.167	3.245	4.400	3.433	4.033	3.955
	B2	2.300	1.967	2.167	2.145	3.733	2.733	3.267	3.244
	B3	2.733	2.433	2.567	2.578	3.833	3.200	3.633	3.555
Mean		2.880	2.460	2.630	2.657	3.990	3.120	3.640	3.583
Mean for Planting methods	B1	3.800	2.667	3.167	3.211	4.756	4.133	4.233	4.374
	B2	3.333	2.400	2.889	2.874	3.656	3.267	3.456	3.460
	B3	3.533	2.644	3.022	3.066	4.389	3.700	3.944	4.011
Mean		3.211	2.874	3.067		4.374	3.459	4.011	
L.S.D. at 5% for :									
Cultivars (V)		0.13				0.1			
Irrigation (I)		0.07				0.08			
Planting methods (B)		0.06				0.1			
V X I		-				-			
V X B		-				-			
I X B		0.11				0.17			
V X I X B		-				0.16			

V= Cultivars, B= planting methods, I= irrigation, V_1= variety sids12, B_1= Drill, I_1= 21 day, V_2= variety Giza 168, B_2= B. cast, I_2=28 day, V_3= variety Misr 2, B_3= furrows, I_3= 35 day.

Table (6): Number of spikes /m2of some wheat varieties as affected by irrigation intervals and planting methods in 2017/2018 and 2018/2019 seasons.

Irrigation Intervals	Planting Methods (B)	Season							
		2017/2018				2018/2019			
		Cultivars (V)				Cultivars (V)			
		Sids 12	Giza 168	Misr 2	Mean	Sids 12	Giza 168	Misr 2	Mean
		V_1	V_2	V_3		V_1	V_2	V_3	
I_1	Drill $_{(B1)}$	375.3	346.3	362.3	361.3	379.7	349.7	365.0	364.8
	B. cast $_{(B 2)}$	260.7	244.3	249.0	251.3	295.7	272.7	288.0	285.5
	Furrows $_{(B3)}$	292.0	264.7	279.3	278.7	321.3	285.7	308.3	305.1
Mean		309.3	285.1	296.9	297.1	332.2	302.7	320.4	318.4
I_2	B1	371.0	325.3	346.0	347.4	377.7	337.3	359.3	358.1
	B2	257.0	238.0	239.7	244.9	273.0	254.0	264.3	263.8
	B3	271.0	240.3	249.3	253.5	319.0	280.7	304.3	301.3
Mean		299.7	267.9	278.3	282.0	323.2	290.7	309.3	307.7
I_3	B1	310.3	268.3	282.0	286.9	316.7	278.7	300.0	298.5
	B2	235.3	226.7	230.3	230.8	247.3	230.0	236.3	237.9
	B3	247.7	232.7	241.3	240.6	250.7	238.7	247.0	245.5
Mean		264.4	242.6	251.2	252.7	271.6	249.1	261.1	260.6
Mean for Planting methods	B1	352.2	251.0	270.2	291.1	358.0	272.0	297.0	309.0
	B2	313.3	236.3	245.9	265.2	321.9	252.2	268.3	280.8
	B3	330.1	239.7	256.7	275.5	341.4	262.9	286.6	297.0
Mean		291.1	265.2	275.5		309.0	280.8	297.0	
L.S.D. at 5% for :									
Cultivars (V)		2.98				3.86			
Irrigation (I)		4.05				3.55			
Planting methods (B)		2.44				2.66			
V X I		7.01				6.15			
V X B		4.22				4.61			
I X B		4.22				4.61			
V X I X B		7.32				7.99			

V= Cultivars, B= planting methods, I= irrigation, V_1= variety sids12, B_1= Drill, I_1= 21 day, V_2= variety Giza 168, B_2= B. cast, I_2=28 day, V_3= variety Misr 2, B_3= furrows, I_3= 35 day.

Table (7): Grains yield (ardab/fed) of some wheat varieties as affected by irrigation intervals and planting methods in 2017/2018 and 2018/2019 seasons.

Irrigation Intervals	Planting Methods (B)	Season							
		2017/2018				2018/2019			
		Cultivars (V)				Cultivars (V)			
		Sids 12	Giza 168	Misr 2	Mean	Sids 12	Giza 168	Misr 2	Mean
		V_1	V_2	V_3		V_1	V_2	V_3	
I_1	Drill $_{(B1)}$	22.27	20.22	21.69	21.39	23.33	20.95	21.87	22.05
	B. cast $_{(B 2)}$	17.67	16.19	16.96	16.94	18.09	16.57	17.33	17.33
	Furrows $_{(B3)}$	21.87	18.87	19.57	20.10	22.14	19.43	20.69	20.75
Mean		20.60	18.43	19.42	19.48	21.19	18.98	19.96	20.04
I_2	B1	21.27	19.24	20.14	20.22	22.57	20.14	21.55	21.42
	B2	16.79	15.87	16.43	16.36	17.16	16.20	17.12	16.82
	B3	21.34	18.04	18.87	19.42	21.80	18.55	20.21	20.19
Mean		19.80	17.72	18.48	18.67	20.51	18.30	19.63	19.48
I_3	B1	20.37	18.90	20.12	19.76	21.00	19.86	20.45	20.44
	B2	15.85	14.08	14.33	14.76	16.68	14.35	16.08	15.73
	B3	19.69	16.91	17.97	18.19	20.23	17.84	18.36	18.81
Mean		18.64	16.63	17.47	17.57	19.33	17.35	18.30	18.33
Mean for Planting methods	B1	21.30	19.45	20.65	20.46	22.30	20.32	21.29	21.30
	B2	16.77	15.38	15.91	16.02	17.31	15.71	16.84	16.63
	B3	20.97	17.94	18.80	19.24	21.39	18.61	19.75	19.92
Mean		19.68	17.59	18.45		20.33	18.21	19.30	
L.S.D. at 5% for :									
Cultivars (V)		1.76				1.60			
Irrigation (I)		1.97				1.91			
Planting methods (B)		1.38				1.57			
V X I		1.53				1.24			
V X B		1.82				1.39			
I X B		1.77				1.65			
V X I X B		1.59				1.45			

V= Cultivars, B= planting methods, I= irrigation, V_1= variety sids12, B_1= Drill, I_1= 21 day, V_2= variety Giza 168, B_2= B. cast, I_2=28 day, V_3= variety Misr 2, B_3= furrows, I_3= 35 day.

Table (8): Straw yield (ton/fed) of some wheat varieties as affected by irrigation intervals and planting methods in 2017/2018 and 2018/2019 seasons.

Irrigation Intervals	Planting Methods (B)	Season							
		2017/2018				2018/2019			
		Cultivars (V)				Cultivars (V)			
		Sids 12	Giza 168	Misr 2	Mean	Sids 12	Giza 168	Misr 2	Mean
		V_1	V_2	V_3		V_1	V_2	V_3	
I_1	Drill $_{(B1)}$	1.808	1.950	1.843	1.867	2.103	1.738	1.708	1.850
	B. cast $_{(B 2)}$	1.928	1.985	1.948	1.954	1.927	1.978	1.933	1.946
	Furrows $_{(B3)}$	1.985	1.937	2.090	2.004	2.000	2.058	2.137	2.065
Mean		1.910	1.960	1.960	1.943	2.010	1.920	1.930	1.953
I_2	B1	1.893	1.890	1.832	1.872	2.152	1.967	1.797	1.972
	B2	1.860	1.507	1.667	1.678	1.917	1.734	1.817	1.823
	B3	1.743	1.835	1.837	1.805	2.038	1.912	1.983	1.978
Mean		1.830	1.740	1.780	1.783	2.040	1.870	1.870	1.927
I_3	B1	1.817	1.762	1.710	1.763	1.955	1.942	1.653	1.850
	B2	1.637	1.477	1.662	1.592	1.692	1.790	1.713	1.732
	B3	1.642	1.652	1.797	1.697	1.867	1.787	2.003	1.886
Mean		1.700	1.630	1.720	1.683	1.840	1.840	1.790	1.823
Mean for Planting methods	B1	1.839	1.808	1.790	1.821	2.070	1.845	1.968	1.961
	B2	1.867	1.656	1.808	1.777	1.882	1.834	1.919	1.878
	B3	1.795	1.759	1.908	1.812	1.719	1.821	2.041	1.860
Mean		1.813	1.777	1.821		1.961	1.878	1.861	
L.S.D. at 5% for :									
Cultivars (V)		0.05				0.07			
Irrigation (I)		0.04				0.07			
Planting methods (B)		0.05				0.05			
V X I		0.08				0.12			
V X B		-				-			
I X B		0.08				0.09			
V X I X B		0.14				0.16			

V= Cultivars, B= planting methods, I= irrigation, V_1= variety sids12, B_1= Drill, I_1= 21 day, V_2= variety Giza 168, B_2= B. cast, I_2=28 day, V_3= variety Misr 2, B_3= furrows, I_3= 35 day.

Table (9): Protein percentage in grain (%) of some wheat varieties as affected by irrigation intervals and planting methods in 2017/2018 and 2018/2019 seasons.

Irrigation Intervals	Planting Methods (B)	Season							
		2017/2018				2018/2019			
		Cultivars (V)				Cultivars (V)			
		Sids 12	Giza 168	Misr 2	Mean	Sids 12	Giza 168	Misr 2	Mean
		V_1	V_2	V_3		V_1	V_2	V_3	
I_1	Drill $_{(B1)}$	12.48	7.913	9.993	10.13	12.68	9.163	11.25	11.03
	B. cast $_{(B 2)}$	11.66	7.480	8.707	9.283	11.52	6.893	8.937	9.117
	Furrows $_{(B3)}$	11.92	7.667	9.583	9.722	12.31	8.207	9.787	10.10
Mean		12.02	7.687	9.428	9.711	12.17	8.088	9.990	10.09
I_2	B1	11.92	6.873	9.373	9.386	12.50	7.813	9.997	10.11
	B2	10.88	6.873	7.850	8.532	11.02	7.540	8.623	9.060
	B3	11.39	7.063	7.497	8.651	11.44	7.667	8.373	9.160
Mean		11.39	6.937	8.240	8.857	11.65	7.673	8.998	9.441
I_3	B1	11.11	5.937	8.747	8.596	11.50	6.937	8.747	9.060
	B2	9.997	5.813	7.437	7.749	10.11	6.540	7.417	8.020
	B3	10.42	5.623	6.457	7.498	10.50	6.020	7.290	7.936
Mean		10.51	5.791	7.547	7.947	10.71	6.499	7.818	8.339
Mean for Planting methods	B1	11.83	6.908	9.371	9.370	12.23	7.971	9.997	10.07
	B2	10.85	6.722	7.998	8.521	10.88	6.991	8.326	8.732
	B3	11.24	6.784	7.846	8.624	11.42	7.298	8.483	9.066
Mean		11.31	6.805	8.405		11.51	7.420	8.935	
L.S.D. at 5% for :									
Cultivars (V)		0.339				0.325			
Irrigation (I)		0.178				0.295			
Planting methods (B)		0.293				0.289			
V X I		0.309				0.512			
V X B		-				-			
I X B		0.507				-			
V X I X B		-				-			

V= Cultivars, B= planting methods, I= irrigation, V_1= variety sids12, B_1= Drill, I_1= 21 day, V_2= variety Giza 168, B_2= B. cast, I_2=28 day, V_3= variety Misr 2, B_3= furrows, I_3= 35 day.

This may be due to water stress during grain filling stages, induced early senescence, reduced photosynthesis, also, effected on the transferring of carbohydrates from vegetative tissues to the grain and shortened grain filling period. These results are agreement with those obtained by Alsayim *et al.* (2013), Abdelkhalek *et al.* (2015), Seleiman and Abdel-Aal (2018), El-Metwally and Gad (2019) and Mohammed *et al.* (2019). Results showed that the effect of planting methods on all characteristics studied was significant in both seasons. Drilling method was gave the heaviest 1000- grain weight (g) (45.21 and 52.26), grains weight / spike (g) (3.211 and 4.374), number of spikes/ m^2 (291.1 and 309), grains yield ardab/fed (20.65 and 21.30), straw yield ton/ fed (1.821 and 1.961) and protein percentage in grain (%) (9.370 and 10.07) in the first seasons and second seasons, respectively. These results could be to the drilling methods had led to the optimum conditions of good standing, better field air circulation and such effects increased plant vegetative growth. These results are in harmony with those obtained by Ismail *et al.* (2008), El-Ashmouny *et al.* (2011), Mahmoud *et al.* (2016), Hefny *et al.* (2015), El-Sherif *et al.* (2016) and Na-Allah *et al.* (2018). The interactions between cultivars and irrigation intervals were significant in both seasons for all characteristics studied, except grains weight/spike (g) in the both seasons. The interactions between cultivars and planting methods was significant in both seasons for all characteristics studied, except 1000- grain

weight (g) in the second season and grains weight/spike (g), straw yield ton/fed and protein percentage in grain (%) in the both seasons, respectively. The interactions between irrigation intervals and planting methods were significant in the first and second season for all characteristics studied, except 1000- grain weight (g) in the second season and protein percentage in grain (%) in the first season only. Interaction effect of cultivars x irrigation treatment x planting methods was significant for all studied traits in the both seasons, except 1000- grain weight (g) in the first season and grains weight / spike (g) in the second season. One of the most important factors that affect wheat productivity is planting methods and irrigation intervals. Our results showed exposing wheat plants to drought stress by increasing irrigation intervals significantly decrease (1000-grain weight, grain weight/spike, number of spikes/ m^2, grain yield (ardab/ fed), straw yield (ton/fed) and protein (%). Irrigation intervals showed highly significant difference in for all characters study. The highest value resulted from application Irrigation intervals at 21 day compare with the other irrigation intervals planting methods significantly affected on all a previous characters. The highest value on all study characters resulted from using drilling method. There were highly significant differences among wheat cultivars in for all characters under study.

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