Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

Water Controlled Drainage Management and Water Saving of Four Bread Wheat Cultivars and their Effects on Yield and its Components at the North Delta Soils, Egypt

Cross Mark

Genedy, M. S.[1*] and M. K. El-Ghannam[2]

[1] Wheat Research Department, Field Crops Res. Inst., ARC. Egypt.
[2] Soils, Water and Environment Res. Inst., ARC. Egypt.

ABSTRACT

During 2017/2018 and 2018/2019 seasons, two experiments under field conditions have been performed at Sakha Agricultural Research Station (ARC) Experimental Farm in Egypt, to find out the effect of drainage treatments (water table depths) on growth, yield and its components of four wheat cultivars. Every experiment had been in three replications and had been performed in a split-plot design. The main-plots were dedicated to drainage treatments (conventional drainage at 120 cm and two controlled drainage at 80 and 40 cm water table depth). The sub-plots were allocated to wheat cultivars (Sakha 95, Gemmeiza 11, Misr 2 and Giza 168). Data on the amount of water applied to the subsurface drainage system revealed that, the 40 cm treatment saved about 501.9 and 602.28 m^3/fed, or about 23.75 and 28.50% of applied irrigation water in 1st and 2nd as compared to the 120 cm depth treatment. The results revealed that drainage treatment 40 cm below soil surface significantly increased early characteristics, growth and yield and wheat characteristics, giving the highest values of followed in the two seasons, by both controlled drainage and conventional drainage. Sakha 95 cultivar exceeded the other studied wheat cultivars (Gemmeiza 11, Misr 2 and Giza 168) and obtained the highest values for days to heading and maturity and for growth, yield and its components in both seasons. The drainage can be concluded depth 40 cm below soil surface for Sakha 95 and/or Gemmeiza 11 cultivars produced the highest growth and productivity under the conditions of the Sakha district in Egypt's Kafr El-Sheikh Governorate.

Keywords: Wheat, (*Triticum aestivum* L.), drainage, Water table depths, Cultivars, Productivity.

INTRODUCTION

Wheat (Triticum aestivum L.) is Egypt's and the world's most commonly and widely grown crop, as the major largest producer and exporter of food and energy for human nutrition due to its unique protein characteristics (Abedi *et al.*, 2010), which could be processed into a collection of foods such as bread, macaroni, cakes and biscuit. Despite the fact that wheat straw is a valuable livestock feed. Wheat is Egypt's major important winter cereal crop, with a total cultivated area of around 3.1 million feddan and a total production of 8.81 million tonnes at an average of 18.74ardab/feddan in 2019/2020 season (FAO, 2020); however wheat production is not enough for local consumption. For that reason, extensive attempts to increase production of wheat by increasing the area cultivated and maximising yield per unit area have been needed to meet incessant demand and decrease the gap between consumption and production.

These days, the world, particular arid and semi-arid areas, are faced the problem of supplying the expanding population with water and food. These challenges would need reduce water losses and maximize the performance of water drainage to maximise agriculture productivity.

According to Elghannam *et al.* (2016), regulated drainage and other water management activities play an important role in minimising irrigation water use; additionally, controlling the water table location would allow for increased crop water use in situ, resulting in improved irrigation efficiency.

Wahba *et al*. (2008) found that controlled drainage could maintain or increase the yields of the unit by 15-20 % per unit land while improving water irrigation efficiency (yield per unit of water). If the potential on-farm water savings are extended to large areas with controlled drainage, then the potential for Egyptian water saving is large.

Abo-Waly *et al.* (2016) reported that water table depth treatments had a major effect on wheat yield. Wheat yields were highest (3190 and 2952 kg/ fed) in the 1st and 2nd seasons, respectively, at 40 cm depth; however, wheat yields were lower when the water table was below this level.

The obvious role of the agronomical practices such as using promising cultivars and suitable water table depth has very imperative impact on earliness, growth and productivity of wheat. When water table is shallow, it may have a positive (water supply) or negative impacts on crops as soil waterlogging limiting wheat root growth due to reduced soil oxygen and salinization, therefore crop yield could be decreased (Brisson *et al*., 2002 and Nosetto *et al*., 2009).

Cavazza and Pisa (1988) reported that water table depth affects the yield of wheat grain and waterlogging duration. Resulting in a lack of water, at an average depth of 125 cm, maximum was reached, and it declined slightly at deeper water levels. The yield was only 25% of this maximum when the average water table depth during the season was 12 cm, and it reached 82 percent when the average depth was 25 cm.

Liu and Luo (2011) showed that when the water table depth was between 40 and 150 cm, More than 65% of possible

*** Corresponding author.**
E-mail address: mogenedy82@gmail.com
DOI: 10.21608/jpp.2021.161260

evapotranspiration of winter wheat had been met by seasonal groundwater contribution. The water table contribution nearly met the entire water requirement of winter wheat with the overall precipitation in the winter wheat season because the water table from the field was not deeper than 110 cm.

Xu *et al*. (2013) stated that the target depth for groundwater is 1.0-1.5 m, with a view to maintaining crop yields, is suggested for the growth season of wheat. Ghamarnia and Farmanifard (2014) showed that the groundwater-use efficiency and highest yield production under water table levels of 0.80 m for wheat cultivars. Peng *et al*. (2019) revealed that due to the large spatial variation of ground water depth, suitable irrigation schedules for plants in low groundwater areas are very difficult to determine.

Choosing high yielding wheat cultivars is undoubtedly crucial for growing productivity per unit area. Thus, many Egyptian and worldwide researchers, Seleem and Abd El-Dayem (2013), Mehasen *et al.* (2014), Abdelsalam and Kandil (2016), Kandil *et al.* (2016), Baqir and Al-Naqeeb (2018), El-Sayed *et al.* (2018), Gomaa *et al.* (2018), Hassanein *et al.* (2018), Khan *et al.* (2019) and Iwanska *et al*. (2020) concluded that there are significant differences among wheat cultivars in earliness (heading and maturity), growth (plant height), yield and its components due to genetic structure differences and their interaction with the environment conditions. This research aims to evaluate wheat cultivars for the best cultivar to use for the study region's conditions of the environment.

Accordingly, this investigation was designed to decide the effect of drainage treatments (water table depths) on growth, yield and its components of four wheat cultivars under conditions of Sakha district, Kafr El-Sheikh Governorate, at North Delta Soils, Egypt.

MATERIALS AND METHODS

Under field conditions, two experiments were performed on the farm experimental of Sakha Agricultural Research Station, (ARC), Egypt, during 2017/2018 and 2018/2019 seasons.

The experiment was carried out with three replications in a split-plot design. The experiment incorporated twelve treatments comprising, three drainage treatments and four wheat cultivars (Table 1). The main-plots were devoted for three drainage treatments *i.e.* conventional drainage (water table depth at 120 cm below soil surface) and two controlled drainage (water table depth at 80 and 40 cm below soil surface).

The area covered by a tile drainage system that has been designed to carry out current research. It is divided into three treatments, each drained through a manhole by three laterals connected to the riser and the spacing of the drain is 20 m.

Construction of controlled drainage system:

"Controlled drainage" the system that wants to keep the ground water level at that depth in the various treatments.

The irrigation and drainage systems must be combined into a single water management system. This means that the irrigation system's operation and the drainage system's management are also in agreement. In this case, the drainage system will be controlled in response to irrigation management and deep percolation to stabilise the flow and water table depth over time. In different treatments controlled drainage devices have been installed. The system consists of 120 cm tall 3" vertical tubing. The lateral within the manhole was connected to the riser at the bottom.

Four wheat cultivars, *ie*, Sakha 95, Gemmeiza11, Misr 2 and Giza168 (Table1), were assigned to the sub-plots. Wheat cultivars from Egypt were obtained from the Wheat Research Section of the Field Crops Research Institute of Egypt's Agricultural Research Center.

Each experimental unit area (sub-plot) occupied an area of 4.2 m^2 and was 1.2 × 3.5 m. Cotton (*Gossypium barbadense* L.) was the preceding summer crop in both seasons.

Table 1. Cross name, pedigree and selection history of the four studied bread wheat cultivars.

Name	Pedigree	Selection history
Sakha 95	PASTOR //SITE/ MO/3/ CHEN/AEGILOPS SQUARROSA (TAUS) //BCN/4 /WBLL1.	CMA01Y00158S- 040POY-040M-030ZTM -040SY- 26M-0Y-0SY-0S.
Gemmeiza 11	BOW "S"/ KVZ"S" // 7C /SER 182 /3 / GIZA168/ SAKHA 61	GM7892-2GM-1GM-2GM-1GM-0GM
Misr 2	SKAUZ/BAV92	CMSS96M03611S -1M-010SY- 010M-010SY-8M-0Y-0S.
Giza 168	MRL/BUE/SERI	CM93046-8M-0Y-0M- 2Y- 0B.

Before preparing the soil, a random measure of the physical and chemical properties of the soil was taken from the experimental field at a depth 0-30 cm beneath the soil surface Page's (1982) process, with the results shown in Table 2.

Table 2. Physical and chemical soil properties at the experimental sites during 2017/2018 and 2018/2019 seasons.

Soil analyses	2017/2018	2018/2019
Soil texture class	**Clayey texture**	
Soil pH (1:2.5 suspension)	8.20	8.50
$CaCO_3$ (Calcimeter method) %	2.10	2.20
O.M. (Walkly & Black method) %	1.51	1.48
Soil CEC (cmol/kg)	31.65	30.36
Available-N (K-sulfate extract) ppm	50.9	52.21
available-P (Olsem-extract) ppm	11.10	12.00
Available-K (Am-acetate extract) ppm	498.0	466.0
Available-Zn (DTPA-extract) ppm	0.98	0.95

Table 3 shows meteorological data for the 2017/2018 and 2018/2019 winter seasons in Sakha district, Kafr El-Sheikh Governorate.

Two ploughings and divisions were used to prepare the experimental area, which was then divided into experimental units with the dimensions mentioned previously. During soil preparation at a rate of 150 kg/fed (one feddan = 4200m2), calcium super phosphate (15.5 % P_2O_5) was applied.

The cultivation took place on 25^{th} and 19^{th} November in the first season and second season, respectively. Wheat seed was sown by broadcasting (afir method) at the recommended rate for every studied cultivar. The nitrogen fertiliser in Ammonium nitrate (33.5% N) was used in two equal doses before first and second irrigation at the recommended level (75 kg N/four). The plants were irrigated for the first period 25 to 30 days after sowing, and then every 21 to 25 days until they reached the dough stage. Except for the factors under this study, common agricultural techniques for growing wheat were followed according to Ministry of Agriculture recommendations.

Table 3. Maximum and minimum monthly temperature (ºC), relative humidity (%) and rainfalls rate* at the site of the experiment during two growing seasons of 2017/2018 and 2018/2019.

Month	Temperature (ºC)				Relative humidity (%)		Rainfall rate (mm)	
	2017/2018		2018/2019		2017/2018	2018/ 2019	2017/2018	2018/2019
	Max.	Min.	Max.	Min.				
November	25.2	11.9	25.9	9.8	58.7	64.6	0.6	0.3
December	22.3	9.2	22.2	8.9	62.9	62.6	91.5	71.4
January	20.8	6.7	20.8	5.4	66.8	60.5	50.1	53.9
February	20.1	7.9	21.2	6.7	59.9	63.7	23.5	28.7
March	22.3	7.8	22.9	6.5	61.8	57.9	14.2	18.5
April	24.9	10.9	26.0	9.9	63.4	58.9	10.9	11.9
May	30.8	14.8	30.3	13.8	51.8	58.5	0.1	0.0

*** The origin of these data is the Agriculture and Soil Reclamation Ministry (ARC), Central Agriculture Guideline Management, Meteorological Agricultural Data Bulletin.**

Applied irrigation water :

A weir installed in the main irrigation canal was used to calculate the amount of applied irrigation water. The amount of water used was obtained from the following:

$$Q = 1.84\, L(H)^{1.5}$$

Where: Q is the amount of applied water (m^3/s), L is the weir's width, and H is the head above the weir .

Water applied (Wa):

Water applied (Wa) was calculated as, Giriapa (1983) :

$$Wa = Iw + Re$$

Where: Iw = irrigation water applied, Re = effective rainfall

The number of days to heading (days) and number of days to maturity (days) were determined by 50 percent heading and physiological maturity as the number of days from sowing to all plants in each sub-plot.

At harvesting time, the following characteristics were randomly selected for each sub-plot:

1. Plant height (cm) measured by 10 plants on average from the surface of the soil to the top of the main stem spike.
2. Number of spikes/m^2; the number of effective tillers per square meter has been measured by counting.
3. Number of grains/spike; the number of grains per spike was determined as an average of ten spikes.
4. 1000-grain weight (g) has been measured in random grains with an average weight of 10 samples.
5. Grain yield (ardab/fed.) was estimated by weighing the grains obtained from the whole plot right after harvesting and then converted to ardab per feddan (one ardab=150 kg).
6. Straw yield (tons/fed.) was weighted in kg/plot, and then it was converted to ton per feddan.

All of the data collected were statistically analysed by the divisional design technique (ANOVA) for the split-plot design as published by Gomez and Gomez (1984) according to a 'MSTAT-C' computer software kit. Means of treatment were compared using the LSD method, as Snedecor and Cochran (1980) describe, at a 5% probability level.

RESULTS AND DISCUSSION

The first effects: Controlled subsurface water drainage on amount of water applied:

Table (4) shows the result of water applied under different controlled drainage treatments, there have been two components to the seasonal water applied (Wa): irrigation water (I.W) and rainfall (R).

Results showed that controlled drainage at 40 cm depth of water table reflected the lowest amount of water applied 1612.8 m^3/fed, (18.5 cm) in the first season distributed on 2 irrigation events and 1510.7 m^3/fed as (17.5 cm) in the second season with 2 irrigation events. Whereas the highest one 2114.7 m^3/fed (30.45cm) was recorded with 120 cm in first season and 2113 m^3/fed (31.84 cm) in second season.

The difference in the amount of water applied in controlled drainage treatments may be attributed to the average rainfall. The decrease in water applied below 40cm depth of water table may be attributed to a control structure maintaining a shallow water table depth, which reduces deep percolation below the root zone by reducing hydraulic gradients and increases capacitation up flow potential by the careful management of water at an acceptable depth for plant water use. Additionally, managing the water table position would allow for increased crop water use in situ, resulting in increased irrigation efficiency and reduced drainage flow (Ayars and Meek, 1994).

Table 4. Controlled drainage affects the seasonal amounts of water applied for different treatments in a wheat crop.

season	Treatments	IW		Rainful	Wa		Water Saving	
		No of Irrigation	cm		cm	m^3/fed	m^3/fed	%
2017/2018	40 cm	2	18.50	19.90	38.40	1612.8	501.90	23.75
	80 cm	2	24.75	19.90	44.65	1875.3	239.40	11.32
	120 cm	2	30.45	19.90	50.35	2114.7	0.00	0.00
2018/2019	40 cm	2	17.50	18.47	35.97	1510.7	602.28	28.50
	80 cm	2	24.85	18.47	43.32	1819.4	293.58	13.90
	120 cm	2	31.84	18.47	50.31	2113.0	0.00	0.00

The water savings in different treatments for wheat crop was 501.90 and 239.4 m3/fed in the first season, for the 40 and 80 cm water table depths, respectively as compared to the 120 cm depth. Under wheat crop irrigation, the 40 cm depth of controlled drainage saved approximately 23.75 % of irrigation water, meanwhile, As compared to the 120 cm depth, the 80 cm depth produced a lower percentage of water savings of 11.32 %.

The same trend was found in the second season, the results indicated that, the 40 cm treatment saved about 602.28 m^3/fed, or about 28.50% of applied irrigation water as compared to the 120 cm depth treatment. These findings are in a great harmony with those obtained by (Wahba, *et al*. 2003), they indicated that, the evaluating of different water table management techniques revealed that by increasing the spacing between drains to (two times) the design spacing and applying the controlled drainage (CD) at depth 60 cm at the beginning of the growing season and switching to free drainage (FD) for the rest of the growing season can be saved around 20% of irrigation water. We can save 15% of irrigation water by using the CD at 60 cm at the beginning of the growing season and increasing drain spacing to 1.5 times, then switching to the FD for the rest of the season.

The amounts of rainfall were sharing in water applied with 19.9 cm in the first season and 18.47 cm in the second season.

The second effects:

1. Drainage treatment:

The studied drainage treatments *i.e.* conventional drainage (water table depth is 120 cm below soil surface) and two controlled drainage (water table depth is 80 and 40 cm below soil surface) significantly affected earliness characters (number of days to heading and number of days to maturity), growth characters (plant height) as well as yield and its attributes (number of spikes/m^2, number of grains/spike, 1000-grain weight, grain yield and straw yield) in the two growing seasons as shown from the obtained results in Tables 5 and 6.

The water table depth at 40 cm below soil surface which significantly led to delay in heading and maturity, while growth and yield and its components of wheat and gave the highest values in both seasons (Table 5 and 6).

However, the controlled drainage (water table depth at 80 cm below soil surface) was accompanied with the second best values of all studied characters, *i.e.*, earliness, growth, yield and its components of wheat after the conventional drainage (water table depth at 120 cm below soil surface) without significant differences between them.

However, the lowest values of all studied earliness, growth, yield and its attributes of wheat resulted from the other conventional drainage (water table depth at 120 cm below soil surface) in the two growing seasons.

It was creditable to point out that the controlled drainage (water table depth of 40 cm below soil surface) and the controlled drainage treatment (water table depth at 80 cm below soil surface) caused increases summed of 7.17 and 2.19% in grain yield and 4.94 and 1.00 % in straw yield of wheat as compared with the other controlled drainage treatment (water table depth at 120 cm below soil surface) over both seasons, respectively.

These increases in earliness, plant height and yield attributes of wheat due to the both controlled drainage treatments as compared with the conventional drainage may be due to the shallow water table 40 cm, wheat plant might had more water with soluble nutrients which led to better growth and delayed days to heading and maturity and improved yield components resulting higher grain yield.

Also, these enhancements in grain and straw yields/fed are mainly due to the increments in plant height (cm), number of spikes/m^2, number of grains/spike, 1000-grain weight (g). These conclusions are in good compliance with those statements by Liu and Luo (2011), Xu *et al.* (2013), Ghamarnia and Farmanifard (2014) and Abo-Waly *et al.* (2016).

Table 5. Number of days to heading and Number of days to maturity, plant height and number of spikes/m^2 of four wheat cultivars as affected by drainage treatments as well as their interactions during 2017/2018 and 2018/2019 seasons.

Characters	Number of days to heading (day)		Number of days to maturity (day)		Plant height (cm)		Number of spikes/m^2	
Treatment	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019
A- Drainage treatment:								
WTD 120 cm	85.24	91.26	134.80	143.80	82.50	102.35	406.30	396.50
WTD 80 cm	87.87	93.81	138.30	148.10	86.49	105.52	425.70	408.80
WTD 40 cm	88.00	94.08	139.00	148.20	89.16	108.64	433.40	440.20
LSD (at 5%)	0.39	0.35	0.40	0.30	1.17	1.09	14.60	13.30
B- Wheat cultivar:								
Sakha 95	88.07	94.36	137.80	148.50	92.66	110.42	464.20	449.10
Gemmeiza 11	87.12	93.75	137.60	146.70	86.19	109.59	433.60	436.80
Misr 2	86.65	93.06	137.10	146.20	86.04	103.83	431.40	434.80
Giza 168	86.29	91.02	136.90	145.40	79.31	98.18	358.00	340.00
LSD (at 5%)	1.01	1.18	NS	0.90	1.41	1.58	31.10	31.60
C- Interaction (F. test):								
A × B	NS	NS	NS	NS	NS	NS	*	*

Table 6. Number of grains/spike, 1000-grain weight, grain yield (ardab/fed) and straw yield (ton/fed) of four wheat cultivars as affected by drainage treatments as well as their interactions during 2017/2018 and 2018/2019 seasons.

Characters	Number of grains/spike		1000-grain weight (g)		Grain yield (ardab/fed)		Straw yield (ton/fed)	
Treatment	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019
A- Drainage treatment:								
WTD 120 cm	49.06	49.60	46.26	34.01	15.05	16.22	5.71	6.18
WTD 80 cm	47.95	51.65	44.29	35.06	15.15	16.72	5.73	6.27
WTD 40 cm	50.58	52.16	47.69	35.52	15.52	17.54	5.90	6.37
LSD (at 5%)	2.05	2.08	0.98	0.86	0.26	0.31	0.02	0.03
B-Wheat cultivar:								
Sakha 95	51.92	63.95	49.77	41.45	15.81	18.14	5.91	6.81
Gemmeiza 11	51.05	50.85	48.21	35.86	15.61	17.37	5.80	6.27
Misr 2	50.50	46.65	43.44	32.02	15.24	16.79	5.78	6.26
Giza 168	43.30	43.10	42.90	30.12	14.30	15.01	5.63	5.76
LSD (at 5%)	1.46	1.55	1.66	1.79	0.40	0.44	0.09	0.10
C- Interaction (F. test):								
A × B	*	*	*	*	*	*	*	*

2. Wheat cultivars performance:

As shown from data in Tables 5 and 6, there were significant differences among the four studied wheat cultivars *i.e.* Sakha 95, Gemmeiza 11, Misr 2 and Giza 168 in earliness characters (number of days to heading (days) and number of days to maturity (days)), growth character (plant height (cm)) as well as yield and its attributes (number of spikes/m^2, number of grains/spike, 1000-grain weight (g), grain yield and straw yields) during the both growing seasons, with exception number of days to maturity in the first season only.

The achieved results from this investigation showed that Sakha 95 cultivar exceeded the other studied wheat cultivars

(Gemmeiza 11, Misr 2 and Giza 168) in number of days to heading and number of days to maturity, plant height, number of spikes/m^2, number of grains/spike, 1000-grain weight, grain yield and straw yield, in the two growing seasons, which reported the highest values of these characters.

Nevertheless, Gemmeiza 11 cultivar ranked secondly after Sakha 95 cultivar and followed by Misr 2 cultivar regarding all studied earliness, growth, yield and its attributes of wheat without significant differences between them in most cases in both seasons. Whereas, Giza 168 cultivar resulted in the lowest values means of all studied earliness, yield and its attributes of wheat in both seasons.

It was creditable to affirm that sowing Sakha 95 cultivar increases summed of 3.37, 7.77 and 20.97 % in grain yield and 5.85, 6.75 and 14.04 % in (straw yields/fed.) of wheat as compared with sowing Gemmeiza 11, Misr 2 and Giza 168 cultivars over both seasons, respectively. These results might be credited to the differences in their genetically constitution and genetic factors makeup of the studied wheat cultivars. These results are in harmony with those reported by Abdelsalam and Kandil (2016), Kandil *et al.* (2016), Baqir and Al-Naqeeb (2018), El-Sayed *et al.* (2018), Gomaa *et al.* (2018), Hassanein *et al.* (2018), Khan *et al.* (2019) and Iwanska *et al.* (2020).

3. Effects of the interaction:

Concerning the effect of the interaction between drainage treatment and wheat cultivar, it was significant on number of spikes/m^2, number of grains/spike, 1000-grain weight, grain yield and straw yields in the two seasons. On the contrary, number of days to heading and number of days to maturity and plant height (cm) were insignificantly affected by the interaction between drainage treatment and wheat cultivar as shown from data obtainable in Tables 5 and 6.

The attained results of this research reveal that the controlled drainage (water table depth of 40 cm below soil surface) with wheat Sakha 95 cultivar resulted in the highest values of number of spikes/m^2 (Fig.1), number of grains/spike (Fig.2), 1000-grain weight (Fig.3), grain yield ardab/fed (Fig.4) and straw yield tons/fed (Fig.5).

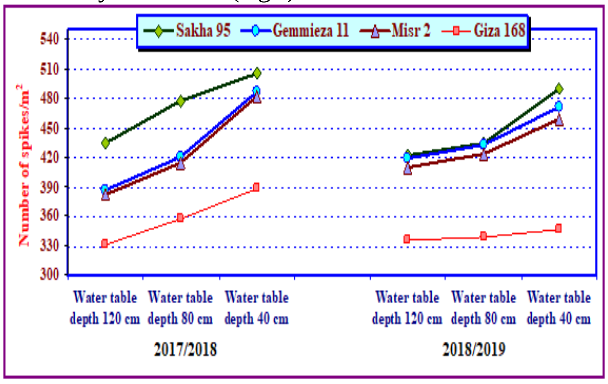

Fig. 1. Number of spikes/m^2 as affected by the interaction between drainage treatment and wheat cultivar during 2017/2018 and 2018/2019 seasons.

The second-best interaction treatment predestined for aforesaid characters was the controlled drainage (water table depth at 80 cm below soil surface) of wheat cultivar Sakha 95 and followed by the conventional drainage of wheat cultivar Gemmeiza 11 in the first and the second seasons.

On the other hand, the lowest values of all studied earliness, growth, yield and its attributes of wheat were produced from the controlled drainage (water table depth at 120 cm below soil surface) of wheat cultivar Giza 168 in both seasons.

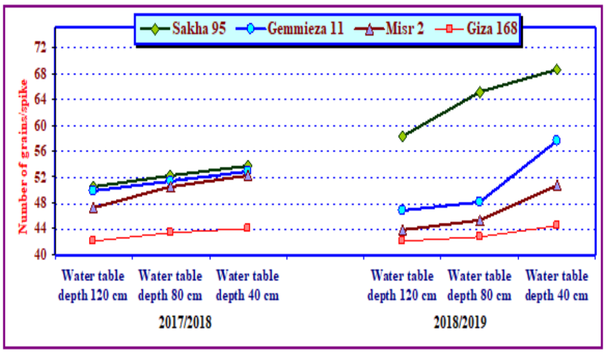

Fig. 2. Number of grains/spike as affected by the interaction between drainage treatment and wheat cultivar during 2017/2018 and 2018/2019 seasons.

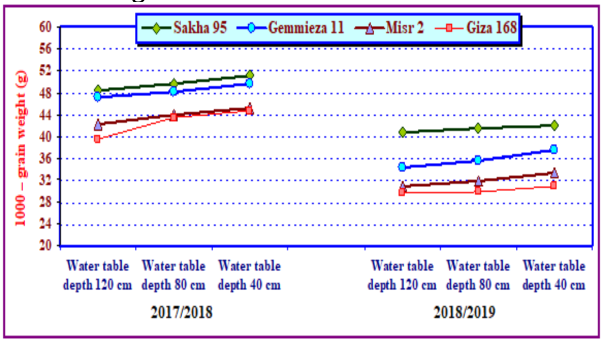

Fig. 3. 1000-grain weight (g) as affected by the interaction between drainage treatments and wheat cultivars during 2017/2018 and 2018/2019 seasons.

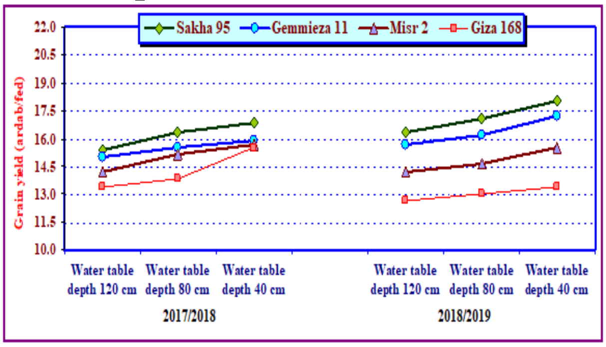

Fig. 4. Grain yield (ardab/fed.) as affected by the interaction between drainage treatments and four wheat cultivars during 2017/2018 and 2018/2019 seasons.

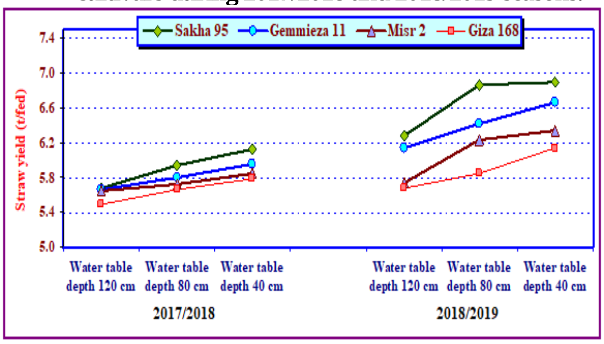

Fig. 5. Straw yield (ton/fed) as affected by the interaction between drainage treatments and four wheat cultivars during 2017/2018 and 2018/2019 seasons.

CONCLUSION

It could be noticed from the results of this study that, under the environmental conditions of the Sakha district, Kafr El-Sheikh Governorate, Egypt, wheat cultivars Sakha 95 and/or Gemmeiza 11 under controlled management 40 cm (water table depth is 40 cm below the soil surface) produced the highest growth and productivity.

REFERENCES

Abdelsalam, N.R. and E.E. Kandil (2016). Assessment of genetic variations and growth/yield performance of four Egyptian and Yemeni wheat cultivars under saline condition. Egypt. Acad. J. Bio. Sci., 7(1): 9-26.

Abedi, T.; A. Alemzadeh and S.A. Kazemeini (2010). Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Australian J. Crop Sci., 4: 384-389.

Abo-Waly, M.E.; S.A. Gaheen; F. F Karageh; M.K. El-Ghannam and A. A Gendy (2016). Impact of controlled subsurface drainage on water saving and the productivity of wheat in North Nile Delta soils (Egypt). (IJSEAS), 2(4):1-15.

Ayars, J.E. and D.W. Meek 1994. Drainage load-flow relationships in arid irrigated areas. Trans. ASAE 37, 431-437.

Baqir, H.A. and M.A.S. Al-Naqeeb (2018). Response of growth and yield of the three bread wheat cultivars to applying yeast powder methods in different concentrations. Intern. J. Agric. Stat. Sci., 14 (1): 327-336.

Brisson, N.; B. Rebisre; D. Zimmer and P. Renault (2002). Response of the root system of a winter wheat crop to waterlogging. Plant Soil, 243: 43-55.

Cavazza, L. and P.R. Pisa (1988). Effect of watertable depth and waterlogging on crop yield. Agric. Water Man., 14(1-4): 29-34.

El-Ghannam, M.K.; M.E. Abo-Waly; S.A. Gaheen; F.F. Karajeh and A.A. Gendy (2016). Controlled drainage effects on nitrate leaching, salinity build-up and sugar beetproduction (Egypt). Merit Res. J. Agric. Sci. Soil Sci. 4 (2), 23-32.

El-Sayed, A.A.; A.M. Omar; S.A. Elsaied and Basma; E. El-Samahey (2018). Yield, yield traits and grain properties of some bread wheat cultivars as influenced by planting dates under Egyptian conditions. J. Plant Production, Mansoura Univ., 9(3): 233-239.

FAO (2020). Food and Agriculture Organization. Faostat, FAO Statistics Division, June, 2020. http://www.fao.org/ faostat/en/#data /QC.

Giriapa, S. (1983). Water use efficiency in agriculture. Oxford-IBH Publishing Co., New Delhi, 6-9.

Ghamarnia, H. and M. Farmanifard (2014). Yield production and water-use efficiency of wheat (Triticum aestivum L.) cultivars under shallow groundwater use in semi-arid region. Arch. of Agro. and Soil Sci., 60(12): 1677-1700.

Gomaa, M.A.; F.I. Radwan; E.E. Kandil and M.A.F. Al-Msari (2018). Response of some Egyptian and Iraqi wheat cultivars to mineral and nanofertilization. Egypt. Acad. J. Bio. Sci., 9(1): 19-26.

Gomez, K.A. and A.A. Gomez (1984). Statistical procedures for agricultural research. 2nd Ed., Jhon Wiley and Sons Inc., New York, pp: 95-109.

Hassanein, M.S., Amal, G. Ahmed and Nabila, M. Zaki (2018). Effect of nitrogen fertilizer and bio-fertilizer on yield and yield components of two wheat cultivars under sandy soil. Middle East J. of App. Sci., 8(1): 37-42.

Iwanska, M., J. Paderewski; M. Stepien and P.C. Rodrigues (2020). Adaptation of winter wheat cultivars to different environments: A case study in Poland. Agronomy, 10, 632; doi: 10.3390/agronomy10050632.

Kandil, A.A.; A.E.M. Sharief; S.E. Seadh and D.S.K. Altai (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.

Khan, F.U.; M. Khan; S.G. Khattak; Z. Iqbal; J. Iqbal and Z. Saleem (2019). Performance of some improved bread wheat varieties grown in Khyber Pakhtunkhwa, Pakistan. Adv. Plants Agric. Res., (1): 191-193.

Liu, T. and Y. Luo (2011). Effects of shallow water tables on the water use and yield of winter wheat (*Triticum aestivum* L.) under rain-fed condition. Australian J. of Crop Sci., 5(13):1692-1697.

Mehasen, S.A.S.; N.Kh. El-Gizawy; A.M. Sharoba; S.A. Soliman and T.R.M. Khalil (2014). Yield and chemical composition of bread wheat cultivars as affected by some skipping irrigation. Minufiya J. Agric., 39 (3):1-6.

Nosetto, M.D.; E.G. Jobbagy; R.B. Jackson and G.A. Sznaider (2009). Reciprocal influence of crops and shallow ground water in sandy landscapes of the inland pampas. Field Crop Res., 113: 138-148.

Page, A.L. (1982). Methods of soil analysis, Part 2. chemical and microbical properties (2nd Ed.). American Society of Agronomy. In Soil Sci. of Amer. Inc. Madison Wisconsin, USA.

Peng, Z.; B. Zhang; J. Cai; Z. Wei; H. Chen and Y. Liu (2019). Optimization of spring wheat irrigation schedule in shallow groundwater area of Jiefangzha region in Hetao irrigation district. Water, 11, 2627; doi:10.3390/ w11122627.

Seleem, S.A. and S.M. Abd El-Dayem (2013). Response of some wheat cultivars to nitrogen fertilizer levels. J. Plant Production, Mansoura Univ., 4(5):721-731.

Snedecor, G.W. and W.G. Cochran (1980). "Statistical Methods" 7th Ed. The Iowa State Univ. Press, Iowa, USA.

Wahba, M.A.S.; M.A. EL-Ganainy; and M. H. Amer (2008).Water table management strategies for irrigation water saving. IWTC 12, Alexandria, Egypt.

Xu, X.; G. Huang; C. Sunc; L.S. Pereirad; T.B. Ramosd; Q. Huang and Y. Hao (2013). Assessing the effects of water table depth on water use, soil salinity and wheat yield: Searching for a target depth for irrigated areas in the upper Yellow River basin. Agric. Water Man., 125: 46-60.

إدارة مياه الصرف المتحكم فيها وتوفير المياه لأربعة أصناف من قمح الخبز وتأثيرها على المحصول ومكوناته في أراضى شمال الدلتا، مصر

محمد سعيد جنيدي[1]* و محمد خطاب الغنام[2]

[1]قسم بحوث القمح ـ معهد بحوث المحاصيل الحقلية ـ مركز البحوث الزراعية ـ الجيزة ـ مصر

[2]معهد بحوث الأراضى و المياه و البيئهـ مركز البحوث الزراعيهـ الجيزهـ مصر

أقيمت تجربتان حقليتان تحت الظروف الحقليه بالمزرعه البحثيه بمحطة البحوث الزراعيه بسخا، مركز البحوث الزراعية- مصر، خلال الموسمين الشتويين 2018/2017 و 2019/2018 لدراسة تأثير معاملات الصرف المتحكم به (أعماق منسوب المياه) على صفات التبكير, وصفات النمو والمحصول ومكوناته لأربعة أصناف من قمح الخبز. نفذت هذه التجربه فى تصميم القطع المنشقة فى ثلاثة مكررات. و تم تخصيص القطع الرئيسيه لمعاملات الصرف (الصرف التقليدي على عمق 120 سم تحت سطح التربة، وعمق منسوب المياه عند 80 و 40 سم تحت سطح التربه). وخصصت القطع الشقية لأصناف القمح (سخا 95، جميزة 11، مصر 2 وجيزة 168). أظهرت النتائج المتحصل عليها أن معاملة الصرف (عمق المياه الجوفية 40 سم تحت سطح التربة) أدى إلى زيادة معنوية في صفات التبكير والنمو والمحصول ومكوناته للقمح وأعطى أعلى القيم، يليه الصرف المتحكم به (عمق المياه الجوفية 80 ثم 120 سم تحت سطح التربة) في كلا موسمين الزراعه. و تفوق صنف القمح سخا 95 على الأصناف الأخرى المدروسه (جميزة 11، مصر 2 وجيزة 168) وسجل أعلى قيم لصفات التبكير والنمو والمحصول ومكوناته في موسمي النمو تحت هذه الدراسه. ومن هذه النتائج المتحصل عليها فى هذه الدراسة يمكن إستنتاج أن الصرف تحت سطحى عند عمق منسوب المياه 40 سم تحت سطح التربه) لصنف القمح سخا 95 أو صنف جميزه 11 أعطى أعلى القيم للنمو والإنتاجيه فى صفات التبكير, والنمو والمحصول ومكوناته, تحت الظروف البيئية بمنطقة سخا- محافظة كفر الشيخ- شمال الدلتا- جمهورية مصر العربيه.