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Evaluation of Some Sunflower Genotypes under Three Levels of Drip Irrigation System in Sandy Calcareous Soil

[1]Heba M. Noaman, [1]Asmaa A. Ahmed, [2]Abd ElGalil M.A.S. and [3] Hefzy M.

[1]Oil Crops Res. Dept., Field Crops Res., Inst., Agric. Res. Cent., Giza, Egypt.
[2]Central Laboratory of Organic Agriculture, Agriculture Research Center, 9 Gamaa Street, 12619
[3]Water Req. and Field Irrig. R.D., Soils, Water and Environment Res. Inst., 9 El - Gammah St. El - Giza Institution, ARC, 12112, Egypt. Giza, Egypt.

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ABSTRACT

The field experiment was conducted at Arab El-Awamer Research Station, Assuit Governorate, Agricultural Research Center, during two successive seasons of 2018 and 2019 to evaluate the response of three sunflower genotypes to three drip irrigation regimes. Afield experiment were organized using the split plot design in randomized complete block design with three replicates arrangementby adding drip irrigation regimes (100% ETc, 80% ETc and 60% ETc) in the main plots and sunflower genotype (Giza 120, Giza 102 and Sakha 53) in sub plots. The results showed that Giza 120 recorded the highest stem diameter (2.39, 2.51 cm), 100-seed weight (7.48, 6.89 g) seed yield/plant (47.50, 46.73 g), seed yield/fed (916.67, 830.00 kg/fed) and seed oil percentage (40.374, 39.517 %), while it was latest at 50% flowering (51.55 and 52.1 days) at first and second season respectively, followed by Sakha 53 in both seasons. From different drip irrigation regimes 100% ETc was superior all other treatments in this respect and registered the highest mean values of all studied yield attributes, seed yield/fed (1097.8 and 1045.6 kg/fed) and oil yield/fed (453.96 and 436.3 kg/fed) in both seasons, while it cause latest on 50% flowering. The interaction between genotype and irrigation regimes significantly effected on sunflower yield attributes. The highest mean values of seed yield/fed (1200.0 and 1130.0 kg/fed.) and oil yield/fed (503.49 and 489.85 kg/fed.) was recorded from applied 100%Etc to Giza 120 at both growing season respectively. Irrigation water use efficiency (IWUE) as affected by irrigation levels and sunflower genotypes for sunflower genotypes, data showed that there was significant difference between the three studied genotype. Giza 120 was significantly superior in IWUE in both seasons.The interaction between water regimes and genotype was significantly affected on IWUE, the highest amount was recorded by applied 100% ETc to Giza 120 genotype.

Keywords: Drip irrigation, Seed yield, Irrigation water use efficiency, Sunflower Genotypes.

1. Introduction

Sunflower is being one of the most important oilseed crops worldwide (FAO 2020), oil of sunflower is ranked as first healthy vegetable oil because it contains higher amount of essential unsaturated fatty acid and lower amount of saturated fatty acid (Hamza and Safina 2015). At Egypt there was big difference between consumption of oil which is always increase by increasing population and domestic production of oil, the production does not exceed 2% so more than 97% of needed oil has been imported. The only solution to reduce this gab is increasing the growing area of oilseed crop especially sunflower because it is highly adapted to different type of soil and climate conditions Beside that sunflower is a short duration crop that can fit well in the crop rotation in the Nile Delta and its Valley as a single or double crop in the summer season. There was many previous investigations has been recorded that there was a significant different on yield and its component among different sunflower genotype like (Salem *et al.,* 2012, Kassab *et al.,* 2012, Abdel-Motagally *et al.,* 2015, ElAwady *et al.,* 2017 and Majid *et al.,* 2022).

Corresponding Author: Hefzy M., Water Req. and Field Irrig. R. D., SWER Institution, ARC, 12112, Egypt. Giza, Egypt. mohamed.hefzy@arc.sci.eg- mhefzy2005@yahoo.com

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Drought stress is a major a biotic stress that effect on yield and its components of different crops, sunflower genotypes has different response to water deficit almost there was reduction in sunflower yield from 15-50% due to water deficit (kassab *et al.,* 2012). Water deficit during seed development reduces the seed size which resulting in lower yield probably by its effect on the photosynthesis rate and also by hastening leaf senescence (Reddy and Reddi 2012). Geetha *et al.* (2012) indicate that water deficit during bud initiation stage caused significant reduction in total dry matter (21%) compared to full irrigation irrespective of the genotype tested. Buriro *et al.* (2015) revealed that the discontinuation of irrigation water after 45 or 60 days resulted in severe negative effects on growth yield components and seed yield ha-1 while sunflower irrigated five times i.e., during all the growth stages, resulted maximum values for growth and yield components including highest seed yield. Consequently, Majid *et al.* (2022) believed that with increasing levels of deficit irrigation stress onward, grain yield decreased significantly, which could be due to a decrease in head diameter and decrease in the number of seeds as well as 100-achene weight and LAI. It can be considered that with different levels of drip irrigation each genotype behaved different behavior according to their genetic makeup. It is generally believed that to realize a better performance in adapted breeding cultivars, traits which increase grain yield under drought conditions must be recognized and used as selection criteria along with grain yield. Breeding methods and drought- resistant cultivars allow optimum utilization of semi-arid regions and increase their cultivated area and efficiency (Mazaffari *et al.,* 1996).

The aim of this study is to evaluate three sunflower genotypes under three different levels of drip irrigation and their effect on growth yield components and yield beside water use efficiency.

2. Materials and Methods

Field experiment were carried-out at the Experimental Farm of Arab El-Awammer Research Station, ARC, Assiut Egypt (which, lies between latitude 27°, 03′ N and longitude 31°, 01′ E and the altitude of the area is 71 m) during two successive growing seasons, 2018 and 2019 to study the three sunflower genotypes under three regimes of drip irrigation on yield and its components. The climatic data of the experimental area during the growing seasons (2018 and 2019) are presented in Table 1.

Table 2 shows chemical and physical properties of the soil. Saturation extracts conductivity (EC), pH, cations and anions of experimental sites were analyzed according to Page *et al.,* (1982) and chemical analysis of the irrigation water. The irrigation water was slightly saline (EC 4.6 dSm^{1}).

2.1. Experimental design and Treatments

The experimental layout was a split-plot in a randomized complete blocks design (RCBD) with three replications. Irrigation regimes were arranged in the main plots, sunflower genotypes were assigned to sub-plots.

Irrigation regimes (IR).

1: Irrigation with amounts of water equal to 100% ETc.
2: Irrigation with amounts of water equal to 80% ETc.
3: Irrigation with amounts of water equal to 60 % ETc.

Sunflower genotype (SG)

1: Giza 120
2: Giza 102
3: Sakha 53

2.2. Cultural practices:

Sunflowers seeds were drilled in one side of ridge (50 cm width), with one plant/hill and 20 cm between hills. The plot size was 20 m^2. Sunflower was sown on 15^{th} and 16^{th} of May 2018 and 2019 seasons. Calcium super phosphate (15.5% P_2O_5) at rate of 200 (kg /fed.) was applied during soil preparation in the two seasons. Potassium sulfate (48.0% K_2O) was applied on one dose at rate of 50 (kg /fed.) and mineral nitrogen fertilizer at rate of 60 kg N/fed., of ammonium nitrate, 33.5% N" was applied in three doses.

Table 1: Average monthly meteorological data of Assiut weather station during the two growth seasons of 2018 and 2019.

	Temperature (C°)		Relative Humidity	Wind Speed	Sunshine
	Max	**Min**	**%**	**km/h**	**hours**
			2018		
August	37.6	24.3	40.7	19.8	11.9
September	35.5	22	46.2	20.5	10.8
October	32.6	18.9	46.5	18.1	10.0
November	26.5	13.1	53.8	14.7	9.4
			2019		
August	38.9	25	35.6	14.5	11.9
September	35.4	22.2	45.7	18.2	10.8
October	33.6	19.3	47.6	16.9	10.0
November	28.6	13.7	52	14	9.4

Table 2: Some physical and chemical properties of the experimental soil.

Soil Property	Values
Soil texture	Sandy calcareous
Sand %	89.9
Silt %	7.1
Clay %	3
Total $CaCO_3$%	31.14
pH (1:1 suspension)	8.23
EC (dS m-1)	0.46
Organic matter%	0.20
Macronutrients (mgkg-1 soil):	
Total nitrogen	100
Available phosphorus	8.22
Available K	46
DTPA-extractable (mg kg^{-1} soil)	
Fe	0.622
Mn	0.356
Zn	0.142

* Each value represents the mean of three replications

2.3. Measured traits

2.3.1. Yield and Yield attributes

The number of days to 50% flowering was determined from each split plot, five randomly selected plant was selected from each plot at harvest time and left the head to dried then determined different parameters of yield attributes like plant height (cm), stem diameter (cm), head diameter (cm), number of seeds plant-1, 100 seed weight, and seed weight plant-1.Seed yield (kg /fed) heads of central ridges from each plot was harvested and left for two weeks until fully air dried then seed separated, collected and weighted and converted to (kg/fed.)

Oil percentage (%) estimated by extraction using Soxhlet apparatus and petroleum ether (bp 40-60°C) as solvent according to A.O.A.C. (1995). Oil yield (kg/fed) Oil yield = Seed yield fed-1 × oil percentage.

2.3.2. Irrigation-water measurements and crop-water relations.

Crop evapotranspiration (*ET*c) (Allen *et al.,* 1998).

$$ET_C \quad ET_O \ x \ Kc$$

Where: -

ETc = Crop evapotranspiration.

ET0 = Reference evapotranspiration. CROPWAT model (8)

Kc = Crop coefficient for mean crop (sunflower), from FAO paper 56

2.3.3. Applied irrigation water

The amounts of actual irrigation water applied under each irrigation treatment were determined using the following equation: James (1988).

$$I.\,Ra = \frac{ET_C + Lf}{Er}$$

Where:
I.Ra = total actual irrigation water applied mm/ interval.
ETc = Crop evapotranspiration (mm)
Lf = leaching factor 10 %.
Er = irrigation system efficiency.
Irrigation water use efficiency (IWUE):
The irrigation water use efficiency (IWUE) values were calculated as follows: (Vits, 1965).

$$IWUE = \frac{\text{Grain or Seed yield (Kg/fed.)}}{\text{Irrigation water requirements } (m^3/\text{ fed.})}$$

2.4. Statistical Analysis

Data were statistical analysis of variance using Statistix 8.1software (**Analytical Software, 2005**). Means were compared for significant differences using the LSD at $p \leq 0.05$.

3. Results and Discussion

3.1. Effect of sunflower genotypes

Data in Table 3 revealed that all studied character was significantly difference among three studied genotype except head diameter (cm) at both season. Data show that Giza 120 recorded the highest stem diameter (2.39, 2.51 cm), head diameter (17.28, 16.50 cm), 100-seed weight (7.48, 6.89 g) seed yield/plant (47.50, 46.73 g), seed yield/ fed (916.67, 830.00 kg/fed) and seed oil percentage (40.37, 39.51 %), while it was latest at 50% flowering(51.55 and 52.1 days) at first and second season respectively, followed by Sakha 53 which recorded (2.28, 2.40 cm) stem diameter, (17.18, 15.39 cm) head diameter, (6.62, 6.42 g) 100-seed yield, (46.11, 45.30 g) seed yield/plant, (866.67, 784.44 kg/fed) seed yield/fed and (37.67, 36.85 %) seed oil percentage. Recorded Giza 102 earlier in 50% flowering (45.44 and 46.88 days) in both seasons, the variation among three tested genotypes may be due to genetic variation and their adaptation and interaction with environmental condition. These results are agreement with Ahmed *et al.,* (2021), Abdel-Motagally *et al.,* (2015), Samia *et al., (*2012) and Saad and Al-Doori (2014). The superiority of Giza 120 followed by Sakha 53 at seed yield and oil yield kg /fed may be due to increase the number of photosynthetic leaves per plant and then increase the dry matter accumulation which led to improved most of seed and yield character Similar finding was reported by Abd EL-Satar *et al.,* (2017) and ElAwady *et al.,* (2017). This varied range of difference is available in the present materials that can help the Egyptian breeder in any breeding program to selection for earliness.

3.2. Effect of drip irrigation regimes

The investigated data in table (4) recorded that a significant effect of three drip irrigation levels on all studied traits at both seasons. 100% ETc was superior on other drip irrigation levels and recorded the highest mean value of all yield and its components. The treatment recorded (135.7 and 147.5 cm) plant height, (2.52 and 2.64 cm) stem diameter, (18.80 and 17.04 cm) head diameter, (7.40 and 7.80 g) 100 seed weight, (47.73 and 46.61 g) seed yield /plant, (1097.8 and 1045.6 kg/fed) seed yield, (41.21 and 41.58 %) oil percentage, (453.96 and 436.30 kg/fed) oil yield, while the earliest in flowering 60% Etc recorded (45.22 and 46.55 days) in two seasons, was the earliest in flowering in 60% Etc can help the Egyptian breeder in short aiming, flowering earliness is around (7 days) in first season, while in second season around (6 days) at harvest. The remarkable increase in yield components by adding 100% ETc might be due to apply proper amount of water that meeting water requirements of sunflower during vegetative, leaf development and flowering stage Hamid Reza (2013).

Table 3: Effect of sunflower genotype on yield and its attributes in 2018 and 2019 seasons

Genotypes	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	Head diameter (cm)	100 Seed weight (g)
			Season 2018		
Giza 120	51.55 a	124.3 a	2.39 a	17.28 a	7.48 a
Giza 102	45.44 c	100.2b	2.09 b	13.75 a	6.60 b
Sakha 53	50 **b**	127.6a	2.28 a	17.18 a	6.62 b
			Season 2019		
Giza 120	52.1 a	135.2 a	2.51 a	16.502 a	6.89 a
Giza 102	46.88 b	108.6 b	2.18 b	12.826 a	5.94 b
Sakha 53	51.4 a	138.0 a	2.40 a	15.398 a	6.42 b

Table 3: Cont.

Genotypes	Seed yield / plant (g)	Seed yield / fed (kg)	Seed Oil (%)	Oil yield / fed (kg/fed)
Giza 120	47.50 a	916.67 a	40.37 a	346.50 a
Giza 102	41.96 b	721.11 c	35.62 c	256.71 b
Sakha 53	46.11 a	866.67 b	37.67 b	350.11 a
Giza 120	46.73 a	830.00 a	39.51 a	324.60 a
Giza 102	40.94 b	666.67 c	34.58 c	24.085 b
Sakha 53	45.30 a	784.44 b	36.85 b	320.35 a

Average having the same letter are not significant at 5% level according to Duncan's multiple range test.

Table 4: Effect of irrigation regime on yield and its attributes in 2018 and 2019seasons

Irrigation regimes	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	Head diameter (cm)	100 Seed weight (g)
			Season 2018		
100%Etc	52.22 **a**	135.7 a	2.52 a	18.80 a	7.40 a
80%Etc	49.55 b	113.8 b	2.20 b	16.20 b	6.74 b
60%Etc	45.22 c	102.4 c	1.04 c	12.33 b	3.58 b
100%Etc	52.44 a	147.5 a	2.64 a	17.04 a	7.80 a
80%Etc	51.44 a	123.6 b	2.32 b	15.32 b	6.07 b
60%Etc	46.55 b	110.6 c	1.13 c	12.35 b	3.90 b

Table 4: Cont.

Irrigation regimes	Seed yield / plant (g)	Seed yield / fed (kg)	Seed Oil (%)	Oil yield / fed (kg/fed)
			Season 2019	
100%Etc	47.73 a	1097.8 a	41.21 a	453.96 a
80%Etc	45.51 b	907.8 b	36.68 b	334.05 b
60%Etc	37.34 b	498.9 c	33.05 c	165.31 c
100%Etc	46.61 a	1045.6 a	41.58 a	436.30 a
80%Etc	44.44 b	806.7 b	37.73 b	305.01 b
60%Etc	36.93 b	428.9 c	34.35 c	147.49 c

Average having the same letter are not significant at 5% level according to Duncan's multiple range test.

These results are in harmony with Hefzy *et al., (*2012), Abdel-Motagally *et al., (*2015), Selin and Necdet (2016), Saleh and Fathy, (2018), Harby and Fathy, (2021). On the other hand the lowest parameters of growth yield components and yield was obtained by applied 60% Etc, the shortest plant height was (102.4 and 110.6 cm), lowest stem diameter (1.04 and 1.13 cm), head diameter (12.33 and 12.35 cm), 100 seed weight (3.85 and 3.90 g), seed yield/plant (37.34 and 36.93 g), hence the effect of applied 60% Etc being on bar with 80% ETc at head diameter cm, 100 seed weight (g) and seed yield/ plant (g) at first and second season respectively, while the lowest seed yield/fed (498.9 and 428.9 kg/fed),seed oil percentage (33.05 and 34.35 %) and oil yield (165.31 and 147.49 kg/fed) was recorded by applied 60% ETc, while it cause earlier in 50% flowering (45.22 and 46.55 days)at both season. The earliest is due to in efficiency water stress, hence sunflower genotypes is highly sensitive to drought from early flowering to achene filling due to inefficiency in regulating the leaf expansion and transpiration rates under inadequate availability of soil moisture (García-López *et al.,* 2014). Water stress caused remarkable decrease in cell elongation, thus leading to reduce photosynthesis process and growth inhibition which is followed by less carbon assimilation, imbalanced mineral nutrition and accumulation of abscise acid (ABA) Farooq *et al.,* (2012). The decrease in the seed yield under deficit water supply was due to decreased sink size and seed weight as a result of lower photosynthetic efficiency and reduced translocation of organic material from source to sink (Amrutha *et al.,* 2007). These results are occupied with many investigations like Abdul Ghani and Muzzammal (2000), Jehan *et al.,* (2010), Selin and Necdet (2016), El Awady *et al.,* (2017) and Majid *et al., (*2022).

3.3. Effect of the interaction between drip irrigation regimes and genotype

The presented data in Table 5 showed that the interaction among drip irrigation levels and different sunflower genotype has significant effect on growth and yield attributes at both season. The longest time to 50% flowering (55.4 and 54.9 day) was recorded by applied drip irrigation at level 100% Etc to Giza 120, the tallest plant height (146.6 and 159 cm) was achieved by applied drip irrigation at level 100% Etc to Sakha 53, the following for this result is (145.3 and 158 cm) that recorded by applied 100% Etc to Giza 120, the largest stem diameter is (2.64 and 2.77 cm), head diameter (18.00 and 17.85 cm) and 100 seed weight (7.46 and 7.20 g) was resulting from sowing Giza 120 with 100% ETc at first and second season respectively. On the other hand, early flowering (42.2 and 43.6 day), shortest plant height (89.0 and 96.0 cm), lowest mean value of stem diameter (0.89 and 0.97 cm), head diameter (12.50 and 11.4 cm) and100 seed weight (3.26 and 3.57 g) was recorded by applied drip irrigation at level 60% Etc to Giza 102 at both seasons.

The highest mean values of seed yield/plant (48.00 and 48.14 g), seed yield/fed (1200.0 and 1130.0 kg/fed), seed oil percentage (43.18 and 43.88 %) and oil yield/fed (503.49 and 489.85 kg/fed) was recorded by the interaction between genetic and environmentally 100% Etc with Giza 120 at both growing season respectively, flowed by Sakha 53. It's clear from this results that Giza 120 and Sakha 53 response positively to supplied high levels of drip irrigation 100% ETc and recorded the highest values of seed and oil yield this may be due to the availability of adequate water and assimilates from source to sink (Nazarli and Zardashti, 2010) moreover the ability of all genotypes to maintain tissue turgor and hence physiological activities Salem *et al.,* (2012). These results are compatible with another research like Kaline *et al.* (2022), Ali (2018) and Abdel-Motagally *et al.,* (2015).

On the other side the lowest values of seed yield/plant was (38.42 and 37.96 g), seed yield/fed. (450.0 and 406.70 kg/fed) was recorded by applied 60% Etc to Giza 102, this result being on bar with applied same drip irrigation level to Giza 120 and Sakha 53 and also lowest seed oil percentage (29.98 and 31.76 %) and oil yield (179.83 and 150.95 kg/fed) was maintain by interaction between Giza 102 and 60% Etc, from these results that was clear that water deficit had negative effect of all studied character of three sunflower genotypes specially Giza 102 is more sensitive to water deficit while Giza 120 and Sakha 53 is tolerance to water deficit, the difference in response to drought among various genotype might be due genetic potential hence it was decide the ability of plant to adapted and induce different defense mechanisms under severe water stress. These results are in parallel with Abdel-Mawgoud (2009), Samia *et al., (*2012), Roumiana *et al.,* (2014), Ali *et al.,* (2014), Abdel-Motagally *et al.,* (2015) and Ali (2018).

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Table 5: Effect of the interaction between drip irrigation regimes and sunflower genotype on yield attributes

Drip irrigation regimes	Genotype	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	Head diameter(cm)	100 Seed weight (g)
			Season 2018			
100%ETc	Giza 120	55.4 a	145.3 a	2.64 ab	18.00 ab	7.46 abc
	Giza 102	48.5 d	115.3 bcd	2.30 bc	16.40 abc	5.79 a
	Sakha 53	53.2 b	146.6 a	2.51 a	17.50 a	6.94 cd
80%Etc	Giza 120	52.6 bc	120.0 b	2.38 ab	17.65 bcd	6.59 de
	Giza 102	45.3 f	96.30 ef	2.07 cd	15.03 cd	4.53 ab
	Sakha 53	51.4 c	125.3 bc	2.16 bc	16.30 cd	5.10 c
60%Etc	Giza 120	47.6 de	106.6 cd	1.17 bc	14.90 cd	4.14 bc
	Giza 102	42.2 g	89.00 f	0.89 d	12.50 d	3.26 c
	Sakha 53	46.4 ef	111.6 de	1.06 cd	13.50 cd	3.33 c
			Season 2019			
100%Etc	Giza 120	54.9 a	158.0 a	2.77 ab	17.85 a	7.20 a
	Giza 102	49.2 b	125.6bcd	2.42 cd	15.6 abc	5.29 cd
	Sakha 53	54.3 a	159.0 a	2.75 a	17.0 ab	6.89 abc
80%Etc	Giza 120	53.4 a	130.0 b	2.50 bc	17.1 bcd	6.93 ab
	Giza 102	48.3 b	104.3	2.17 def	14.3 cd	4.360 e
	Sakha 53	53.3 a	136.6	2.30cde	15.4 bcd	5.92 de
60%Etc	Giza 120	49.2 b	115.6 cd	1.27cde	14.0 cd	4.51bc
	Giza 102	43.6 c	96.00	0.97 f	11.4 d	3.57 e
	Sakha 53	47.6 b	120.3 de	1.15ef	13.0 cd	3.62 e

Table 5: Cont.

Drip irrigation regimes	Genotype	Seed yield / plant (g)	Seed yield / fed (kg)	Seed Oil (%)	Oil yield / fed (kg/fed)
			Season 2018		
100%ETc	Giza 120	48.00 a	1200.0 a	43.18 a	503.49 a
	Giza 102	45.89 b	926.7 b	39.21 c	363.39 b
	Sakha 53	47.29 a	1166.7 b	41.26 b	495.00 a
80%Etc	Giza 120	46.63 bc	1000.0 b	39.18 c	367.10 b
	Giza 102	42.58 c	786.7 c	34.55 f	271.91 c
	Sakha 53	45.32 c	936.7 b	36.31 d	363.15 b
60%Etc	Giza 120	42.58 c	550.0 d	36.19 d	181.35 d
	Giza 102	38.42 c	496.7 de	29.98 g	134.83 e
	Sakha 53	40.01 c	450.0 e	32.98 f	179.83 d
			Season 2019		
100%Etc	Giza 120	48.14 a	1130.0 a	43.88 a	489.85 a
	Giza 102	44.39 b	890.00 b	39.39 c	350.50 b
	Sakha 53	47.29 a	1116.7 a	41.47 b	468.54 a
80%Etc	Giza 120	45.67 bc	870.00 b	40.13 c	332.99bc
	Giza 102	41.48 c	720.00 c	35.70 e	256.99 d
	Sakha 53	44.17 c	830.00 b	37.36 d	325.04 c
60%Etc	Giza 120	41.25c	490.00 d	37.11d	167.46 e
	Giza 102	37.96c	390.00 e	31.76 g	124.05 f
	Sakha 53	40.60c	406.70 e	34.17d	150.95 e

3.4. Irrigation water use efficiency (IWUE).

Irrigation water use efficiency has been calculated for grown sunflower crop from the values of seeds yield (kg/fed.) divided by values of irrigation water applied (m3/ fed.). The irrigation water applied for sunflower genotypes in season 2018 were 2762.55, 2210.04 and 1657.53 (m3/fed.) under 100%, 80% and 60% ETc, respectively and were 2702.50, 2160.0 and 1621.50 (m3/fed,) in season 2019, respectively. The results of IWUE as affected by irrigation regime and sunflower genotypes were present in figure 1. It is obvious that water treatments significantly affected IWUE in the two seasons since irrigation by the highest amount of water (2762.55and 2702.50 m^3/fed) that equal 100% ETc resulted in higher IWUE value as compared with those irrigated by the lowest amount of water (1657.53 and 1621.50 m3/fed.) with regard to genotypes, data showed that there was significant difference between the three studied sunflower genotypes. Giza 120 was significantly superior in IWUE in both seasons. The interaction between water regimes and genotypes was significantly affected on IWUE, the highest amount was recorded by applied 100% ETc to Giza 120 genotype, these results are in parallel with El Awady *et al., (*2017), Kassab *et al., (*2012) and Hamd-Alla *et al.,* (2020).

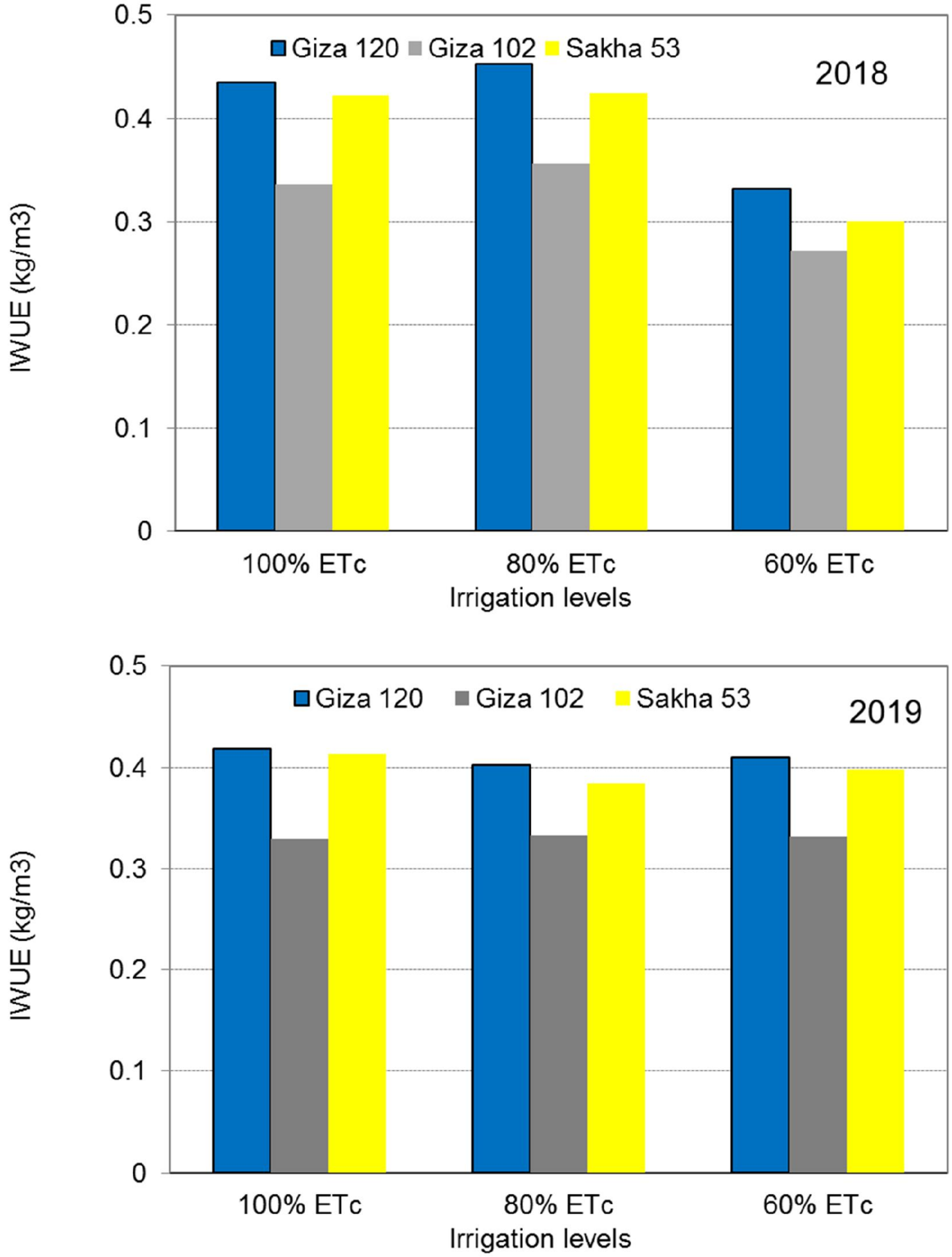

Fig. 1: Effect of drip irrigation regime and sunflower genotype on irrigation water use efficiency in summer seasons of 2018 and 2019.

4. Conclusion

The results of study revealed that 100% ETC of drip irrigation method has potential to increase the production of sunflower genotypes and highest oil content. Also, the largest head diameters, 100-seed weight, seed yield /plant, seed yield /fedden, and oil content in seed were all reported by Giza 120 at 100%ETC of drip irrigation system.

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