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Response of Cantaloupe Yield, Yield Components and Quality to Irrigation Rates and Soil Amendments Under Drip Irrigation in Calcareous Soils

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ABSTRACT

A two-season field experiment was carried out in the newly reclaimed calcareous soils of the Horticulture Research Station at Nubaria region during 2010 and 2011 summer seasons. The objectives of this research were to study the effect of two irrigation rates and five soil amendments treatments on cantaloupe yield, yield components, and quality as well as amounts of applied irrigation water and water use efficiency. The treatments were assessed in a split plot design with three replicates, where the tested irrigation rates e.g. 100 and 80% ETc were represented in the main plots, while and the five soil amendment treatments (control without any soil amendments, organic matter (20 $m^3 fed^{-1}$), organic matter + polymer (0.1% on mass basis) +, organic matter + organic matter+ taflah (0.2% on mass basis) and organic matter+ polymer + taflah +) were allocated to the subplots. The obtained results showed that:1- The growth parameters e.g. number of branches 98^{-1} and branch length were significantly affected by the adopted irrigation rates and soil amendment treatments. Irrigation regime 100% ETc exhibited the highest values for both growth traits, comparable with 80% ETc regime. The soil amendment treatments (OM +Tafla) and (OM + Tafla+ Polymer) resulted in the higher figures of Number of branches $plant^{-1}$ in first and second seasons, respectively. Branch length trait was the highest with (OM + T + P) soil conditioner treatment in the first and second seasons.2- Average number of fruits $plant^{-1}$ was increased with 80% ETc regime in the first and second seasons compared with 100% ETc regime. Average Fruit weight $plant^{-1}$ exhibited different trend, where the values were increased under100% ETc regime, in the first and second seasons, comparing with 80% ETc regime. The soil amendment treatment (OM +Tafla+ Polymer) attained the highest figures of number of fruits $plant^{-1}$ and fruit weight $plant^{-1}$, in first and second seasons.3-Irrigation regime (80% ETc) insignificantly increased total fresh yield of cantaloupe crop, comparable with 100% ETc in the first and second seasons. The adopted soil amendment treatments revealed significant influence to affect total fresh yield of cantaloupe, and (OM + Tafla+ Polymer) resulted in the highest figures reached to 16.36 and 14.77 t/fed, respectively, in the first and second seasons.4- The TSS exhibited a reversed response with the assessed irrigation rates, and increased with lower irrigation rate and vice versa and such trend was true in the first and second seasons. The highest figurers of TSS were recorded with (OM + Tafla) treatment, in the first and second seasons.5- Applied Irrigation Water during 2007 and 2008 seasons were 1342 and 1074 m^3/fed for 100% and 80% ETc regimes, respectively, and the peak of applied water was during fruit formation stage (July). Water use efficiency (WUE) values were increased with 80% ETc regime, comparable with 100% ETc regime. The soil amendment treatment (OM+ Tafla+ Polymer) was superior to improve WUE for cantaloupe in comparison with the others soil amendment treatments.6-Based on the obtained results, it is advisable to irrigate cantaloupe crop with amount of water equals to 80% ETc and supplying the soil conditioner composed of (tafla + organic matter + polymer) to attain the highest fruit yield, growth parameters, yield components, fruit quality, as well as improved water productivity of cantaloupe crop under the circumstances of the present research work.

Keywords: Cantaloupe growth, yield, yield attributes, quality. Irrigation regime, Soil amendments, Water use efficiency

INTRODUCTION

Cantaloupe is considered an exporting crop to European countries as early season production. The nutritional value of cantaloupe is high. The cultivated area with cantaloupe is 27263 feddans in Egypt, where 5452 feddans are cultivated under low tunnels in order to produce early yield and the rest are cultivated in open fields. Egypt has occupied the 8th rank in the countries that produce cantaloupe and the Egyptian production reaches 3.24% from the world production (Ministry of Agricultural and Land Reclamation bulletin, 2002).

The water is a limiting factor for plant production and for the horizontal expansion of the cultivated areas, particularly, in arid and semiarid regions. On accomplishing the sustainable agriculture as an important issue, conserving the available water resources must be a national target. Optimizing the use of irrigation water for all crops and improving the efficiency of applying water by different irrigation systems and regimes are essential in this respect. In this sense, Mirabad *et al.* (2013) studied the growth, yield, yield components and water-use efficiency in irrigated cantaloupes under full (100%) and deficit irrigation regimes (80 and60%), and found that WUE for the deficit irrigation (60%) was 45.9% greater than full irrigation. The authors added that the highest value of sugar content (9.3%) was obtained in irrigation based on 60% ETc. Badr (2007) stated that spatial water distribution and nutrient in root zone under sub -surface drip irrigation, compared with surface drip irrigation, was better and attributed to maintenance of favorable soil water status in the root zone, which in turn helped the plant to utilize moisture as well as nutrients more efficiently from the limited wetted area. The author added that subsurface drip irrigation resulted in significantly higher cantaloupe yield and gave higher NUE and considerable WUE, comparable with surface drip irrigation. Moreover, in outdoor experiment using a volumetric lysimeter, Refaie *et al.* (2012) reported that daily watering level at 100% (Etc) optimized cantaloupe total yield and fruit quality and vegetative growth as well, comparable with 80, and 120% of Etc. Mani (2014) stated that, under full irrigation (100% regime), the maximum values of cantaloupe yield (5.2 t/ha) was obtained, compared with 40 and 70% deficit regimes.

Calcareous soils are characterized with poor soil fertility, low water holding capacity and non-structure. Therefore, using natural and manufactured soil amendments is very useful to improve the soil structure, increase water holding capacity and increase the cation exchange capacity, and such improved soil characteristic are encouraging the nutrients to be more available to the plants. Proper management of the physical soil characteristics are often controlling factors in establishing cantaloupe production and achieving high quality of cantaloupe fruits. Bentonite clay has hundreds to thousands of times more surface area than sand particles, hence it improves nutrient holding capacity of soils and helps provide a better home for soil microorganisms (Croker, 2004). In this respect, Metwalli *et al*. (2004) reported that adding tafla at rate of 10 m3 per feddan to sandy soils improved the soil water holding capacity, but the yield of onion was not increased. Furthermore, Eldardiry, Ebtisam and Abd El-Hady (2015) reported that the use of bentonite on coarse textured (sandy) soils of Nubaria is a promising technology to increase biomass production and rehabilitate the exchange properties of these degraded soils regarding to the its fraction and economic application rates. The authors added that, bentonite or organic matter applied at high rates will supply barley plants substantial amounts of water. In addition, Ozores-Hampton *et al*.(2011) revealed that organic manure amendments affect soil bulk density, water-holding capacity, soil structure, soil carbon content, macro and micronutrients, pH, soluble salts, cation exchange capacity(CEC), and biological properties (microbial biomass). Furthermore, the use of organic amendments may improve soil quality and enhance the utilization of fertilizer, consequently improving the performance of vegetable crops (Ozores-Hampton, 2012). Furthermore, Marculescu *et al*. (2002) concluded that the soil contents of macro and micro nutrients were enhanced due to organic fertilizers supplying, which play an essential role in the plants growth and development. Shafeek *et al*. (2015) reported that addition of organic manure at a higher level (3.2 ton/fed.) improved plant growth, fruit yield, physical and chemical characters of fruit quality of cantaloupe plants. In this respect with sunflower crop under greenhouse conditions, Nazarli *et al*. (2010) found that application of super absorbent polymers mitigated the negative effect of deficit irrigation and improved water use efficiency and yield as well, especially in high rates of polymers (2.25 and 3 gkg-1 of soil). The author added that the rates of polymer addition have the best effect to all characteristics of sunflower in all levels of water stress treatments.

The objectives of this study were to evaluate the effect of two irrigation rates (80% and 100% ETc) and four combinations of soil conditioners, namely organic matter, Tafla and Polymer compared with the control, on cantaloupe yield to investigate, quality, yield components, applied irrigation water and water use efficiency under drip irrigation system in the calcareous soils of Nubaria region, Egypt.

MATERIALS AND METHODS

This study was conducted at Nubaria Horticultural Research Station during the summer growing seasons of 2010 and 2011. The main physical and chemical soil properties of the experimental site, respectively, are shown in Tables 1 and 2. Additionally, Table 3 illustrate the main agro - climatological data (1999–2006 average) for the experimental site. The cantaloupe seeds (Cucumis melo L., Var. Ananass-Dokky) were sown at 1 kgfed^{-1} seeding rate on ridges of 2 m width and spacing between plants 0.5 m. Sowing dates were 5th and 8th May, 2010 and 2011, respectively. Harvest was done on 28th and 30th of August, for the same respective seasons. Cantaloupe growth parameters were measured at the beginning of flowering stage. Chemical fertilization was managed under drip irrigation system according to recommendations of Horticulture Research institute, Agricultural Research Center as follows:

- At the vegetative growth stage until the beginning of flowering: 2 kg ammonium sulphate +2 kg urea + 4 kg potassium sulfate soluble + ½ liter phosphoric acid per feddan were repeated four times a week.
- At flowering stage to the contract: 2 kg ammonium nitrate + 4 kg soluble potassium + ½ liter phosphoric acid per feddan were added four times a week.
- At the contract stage to the growth of the fruit: ½ kg ammonium sulfate + 5 kg ammonium nitrate +8 kg soluble potassium sulfate + ½ liter phosphoric acid per feddan were added four times a week.
- At the stage of fruit development to maturity: 2 kg ammonium nitrate, 4 kg soluble potassium sulfate per feddan were added four times a week.

All other cultural practices including surface soil hoeing (2-3 times), disease and weeds control were executed according to the recommendations of the Ministry of Agriculture. Drip irrigation system was adapted, and consists of a main line (101mm) and a sub-main line (75mm outer diameter) PVC buried lines. The lateral drip line has GR type emitters with a discharge rate of 4 Lh^{-1} and spacing 0.5m apart.

Table 1. The main physical and chemical soil properties of the experimental site.

Soil depth (cm)	Bulk density (Mgm^{-3})	Hydraulic conductivity (ms^{-1})	Particle size distribution (%)			Textural class
			Sand	Silt	Clay	
00 - 15	1.35	$5.4x10^{-6}$	58.9	24.2	16.9	Sandy loam
15 - 30	1.37	$4.9x10^{-6}$	60.3	24.5	15.2	Sandy loam
30 - 45	1.45	$5.8x10^{-6}$	56.7	26.1	17.2	Sandy loam

Table 2. Main chemical properties of the studied soil.

Soil depth (cm)	pH (1:2.5)	EC ($dS\ m^{-1}$)	CEC ($cmol\ kg^{-1}$)	CaCO3 (%)	OM (%)
00 - 15	8.5	3.86	14	25.9	0.12
15 - 30	8.3	4.89	20	24.9	0.14
30 - 45	8.2	5.37	17	26.7	0.26

Soil depth (cm)	Soluble cations ($cmol\ m^{-3}$)				Soluble anions ($cmol\ m^{-3}$)			
	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
00 - 15	20.0	13.0	4.7	0.9	--	10.0	25.0	3.6
15 - 30	9.4	5.1	29.6	5.2	--	11.3	30.3	7.7
30 - 45	29.5	11.4	36.0	6.4	--	20.3	34.3	28.7

Table 3. Main Agro - climatological data at the experimental site (average 1999-2006)*

Month	Max T (C^O)	Min T (C^O)	Wind Speed ($msec^{-1}$)	Relative Humidity (%)	Rail Fall ($mmmonth^{-1}$)	Solar Radiation ($Mjm\text{-}1day^{-1}$)	Epan ($mmday^{-1}$)
January	19.0	9.0	3.0	81	69.3	12.28	1.6
February	19.8	8.6	3.1	79	16.6	13.75	2.0
March	22.5	10.5	3.2	75	7.7	15.18	3.2
April	26.1	13.4	2.9	72	3.0	23.96	4.4
May	28.9	16.0	2.8	76	00	27.47	6.3
June	30.5	19.6	2.8	79	00	28.64	5.9
July	31.6	22.3	3.0	79	00	29.23	6.2
August	32.9	22.2	2.7	78	00	26.86	5.4
September	32.3	20.4	2.5	77	0.8	23.17	5.0
October	29.4	17.5	2.2	76	6.4	17.95	3.7
November	26.4	13.7	2.3	77	11.5	13.07	2.3
December	20.6	10.0	2.8	80	40.1	11.44	1.7

***Supplied by Water Requirements and Field Irrigation Research Department, SWERI**

Experimental design and tested variables:

A split plot experimental design with three replicates was used to assess the adopted treatments. Irrigation rates were allocated in the main plots, while the tested soil amendments were represented the sub-plots as follows:

1. Irrigation rates(Main plots)
2. 100% of ETc, and
3. 80% of ETc.

The amount of applied irrigation water was calculated according to Vermeirer, and Topling, 1984, and was measured by flow meter attached to the irrigation system.

$$AIW = \frac{ETp \times Kc \times Kr \times Interval}{Ea} + LR$$

Where:

AIW = applied irrigation water depth (mm day^{-1}),

ETp= Potential evapotranspiration (mm day^{-1}) values obtained from class A pan and calculated according to FAO (1979) as follows:

$$ETP = Epan \times Kpan$$

Where:

E_{pan} = measured pan evaporation daily values (mm day^{-1}),

K_{pan} = Pan Coefficient which depend on the site's relative humidity, wind speed and its conditions (bare or cultivated). A k_{pan} value of 0.75 was used for the experimental site.

Kc = crop coefficient for cantaloupe (FAO, 1979).

ETc = crop evapotranspiration = ETp x Kc

K_r = reduction factor that depends on ground cover. A K_r value of 0.6 was used since lateral spacing is 2 meters apart (FAO, 1979).

Ea = Irrigation application efficiency. It is calculated as follows:

$$Ea = K_1 \times K_2$$

Where:

K_1 = Emitter uniformity coefficient = 0.90 for the drip system at the site, and

K_2 = Drip irrigation system efficiency = 0.94 for the drip system at the site.

Interval = irrigation intervals (days) = 1 day for the experimental site.

LR = Leaching requirements (No additional water for leaching was added during the growing seasons due to the low EC values of irrigation water and soil profile).

B) Soil amendments :

1. Control, without soil amendments addition,
2. Organic matter,
3. Organic matter + Tafla (OM + T),
4. Organic matter + Polymer (OM + P) …… and
5. Organic matter + Tafla + Polymer (OM + T + P).

The organic matter (chicken manure) was applied at 20 m^3fed^{-1} rate, Tafla and Polymer vinyl acetate were added at 0.2 and 0.1% on soil mass basis, respectively. The Tafla (Bentonite) used in the present investigation is clay in texture and characterized with ECe (4.8 dSm^{-1}), p^H (7.8), $CaCO_3$ (4.6%) and organic matter content (1.7 %). In addition the chemical composition of the used organic matter was p^H (6.3); EC, dSm^{-1} (1.3) and N (nitrate), P and K were 1.4, 74.9 and 48.5 (mgL^{-1}), respectively.The tested soil amendments were incorporated into the surface soil layer (00 -20 cm) during seed bed preparation.

Growth, crop yield, yield components and quality parameters.

The following crop parameters were measured:

1-Number of branches $plant^{-1}$

2-Branch length, cm

3-Total fruit yield, t fad^{-1}

4-Number of fruits $plant^{-1}$.

5-Fruit weightplant^{-1},kg

6-Total soluble solids, TSS% (according to AOAC, 2000).

Water use efficiency (WUE, kgm^{-3})

The water use efficiency was determined according to Mirabad *et al*. (2013) as follows:-

WUE ($tha^{-1}cm^{-1}$) = CY/WA

Where CY = total crop yield, t ha^{-1} and WA = total of water applied, cm^{-1}

It is worthy to mention that, in the present investigation, the yield was expressed as $kgfed^{-1}$ and water applied as m^3fed^{-1}, so WUE will be in kgm^{-3}

Statistical analyses:

The obtained data were statistically analyzed using CoHort software (2004), and the Duncan's multiple range tests was used to compare the differences among treatments means as presented by Steel and Torrie (1984).

RESULTS AND DISCUSSION

1. Growth parameters:

The effect of tested variables on averages of Number of branches $plant^{-1}$ and branch length as growth parameters are illustrated in 4. Results revealed a significant effect of the tested treatments on the two growth parameters.

Number of branches plant^{-1} and Branch length:

Results in Table 4 indicated that, the growth parameters e.g. number of branches plant^{-1} and Branch length were significantly affected by the adopted irrigation rates and soil amendment treatments, and that responses were true in the first and second seasons. Number of branches plant^{-1} was increased with100% ETc regime and reached to 12.20 and 13.64%, respectively, in the first and second seasons higher than that with 80% ETc regime. Furthermore, branch length growth trait exhibited a similar trend, where the value was increased with100% ETc regime by 10.89 and 10.22%, comparable with 80% ETc regime, respectively, in the first and second seasons. Higher values of branches plant^{-1} and Branch length growth traits under with100% ETc regime are coincided with those reported by Refaie *et al*. (2012) who stated that daily watering level at 100% (Etc) optimized cantaloupe vegetative growth, comparable with 80, and 120% of Etc.

The soil amendment treatment (OM +Tafla) resulted in the highest figure of Number of branches plant^{-1} (5.30) in the first season, whereas in the second season, the highest value (5.00) was recorded with (OM + Tafla+ Polymer) treatment, Table 4. The trend was slightly differed with respect to branch length trait, where (OM+T+P) soil conditioner treatment exhibited the highest values e.g. 146.3 and 136.9, respectively, in the first and second seasons. Higher values the tested growth attributes may be attributed to its favorable effect of the assessed soil amendments, compared to the control, on the physical characters of the soil (Marculescu *et al*., 2002 and Ozores-Hampton *et al*., 2011)

Table 4. Effect of tested variables on number of branches plant^{-1} and Branch length (cm) growth traits in 2010 and 2011 seasons.

Treatments	2010		2011		2010	2011
	80% ETc	100% ETc	80% ETc	100% ETc	Mean (Soil amendments)	
	Average Number of branches plant^{-1}					
Control	2.7	3.0	2.3	2.7	2.85	2.50
OM	4.3	4.7	3.3	3.7	4.50	3.50
OM + Tafla	3.3	3.7	3.0	3.3	3.50	3.15
OM + Polymer	4.7	6.3	4.3	5.0	5.50	4.65
OM + Tafla+ Polymer	5.3	5.3	4.7	5.3	5.30	5.00
Mean	4.1	4.6	3.52	4.00		
LSD 0.05	0.470		0.556		0.729	0.842
	Average of Branch length (cm)					
Control	72.8	88.2	69.8	83.2	80.50	76.5
OM	108.3	125.5	104.7	115.5	116.9	110.1
OM + Tafla	95.3	108.7	86.5	102.3	102.0	94.4
OM + Polymer	129.8	145.0	114.7	128.3	137.4	126.1
OM + Tafla+ Polymer	138.7	153.8	130.2	143.5	146.3	136.9
Mean	108.98	124.24	101.18	114.56	116.62	108.8
LSD 0.05	0.729		0.842		7.89	10.13

2. Fruit Yield Attributes

Number of fruits plant^{-1} and fruit weight plant^{-1} yield attributes:

Data indicated that, number fruits plant^{-1} and fruit weight plant^{-1} were significantly affected due to both adopted irrigation rates and soil amendment treatments, and such trends were true in the first and second seasons, Table 5. Average number of fruits plant^{-1} was increased with 80% ETc regime and reached to 3.24 and 1.74%, respectively, in the first and second seasons higher than that with 100% ETc regime. Fruit weight plant^{-1} exhibited different trend, where the values were increased under100% ETc regime and comprised 2.53 and 3.42%, respectively, in the first and second seasons higher than that with 80% ETc regime. In this respect, Keshavarzpour and Rashidi (2011) reported that number of fruits plant^{-1} and fruit weight plant^{-1} were the maximum with 30% Available Water Deficit treatment, compared with 10, 50 and 70% treatments.

Table 5. Effect of tested variables on number of fruits plant^{-1} and fruit weight per plant growth traits in 2010 and 2011 seasons.

Treatments	2010		2011		2010	2011
	80% ETc	100% ETc	80% ETc	100% ETc	Mean (Soil amendments)	
	Average of number of fruits plant^{-1}					
Control	1.47	1.38	1.30	1.21	1.43	1.26
OM	2.03	1.95	1.87	1.78	1.99	1.83
OM + Tafla	1.70	1.65	1.53	1.50	1.68	1.52
OM + Polymer	2.10	2.06	1.93	1.98	2.08	1.96
OM + Tafla+ Polymer	2.27	2.21	2.10	2.11	2.24	2.11
Mean	1.91	1.85	1.75	1.72		
LSD 0.05	0.102		0.189		0.199	0.088
	Average fruit weight per plant					
Control	1.30	1.33	1.20	1.25	1.32	1.23
OM	1.60	1.60	1.50	1.53	1.60	1.57
OM + Tafla	1.50	1.58	1.40	1.44	1.54	1.42
OM + Polymer	1.70	1.73	1.50	1.60	1.72	1.55
OM + Tafla+ Polymer	1.80	1.85	1.70	1.75	1.83	1.73
Mean	1.58	1.62	1.46	1.51		
LSD 0.05	0.185		0.186		0.081	0.093

The soil amendment treatment (OM +Tafla+ Polymer) attained the highest figures of number of fruits plant^{-1} and fruit weight plant^{-1} as cantaloupe yield attributes parameters, and such response was observed in first and second seasons, Table 5. The increases in fruits plant^{-1}, due to soil amendment treatment (OM +Tafla+ Polymer), in the first and second seasons were (56.64 and 40.28%), (11.16 and13.27 %), (25.0 and 27.96%) and (7.14 and7.11 %), respectively, higher than those of the soil amendment treatments Control, OM, OM + Tafla, OM + Polymer. The corresponding increases in fruit weight plant^{-1} were (27.87 and 28.90%), (12.57 and 9.25 %), (15.85 and 17.92%) and (6.01 and 10.40 %) in the same order of soil amendment treatments and seasons. Higher values the tested cantaloupe yield attributes may be attributed to the favorable effect of the assessed soil amendments, compared to the control, on the physical characters of the soil (Marculescu *et al*., 2002 and Ozores-Hampton *et al.,* 2011).

3. Fruit yield and quality:

Fruit yield:

Results in Table 6 show clearly that, there was no significant effect of the tested irrigation rates (80% and 100% ETc) on total fresh yield of cantaloupe crop. However, increases in total fresh fruit yield of cantaloupe with 80% ETc regime amounted to 3.28 and 2.97% higher than 100% ETc regime, respectively, in the first and second seasons. Keshavarzpour and Rashidi (2011). The maximum values of cantaloupe crop yield (29.10 tha^{-1} was obtained in case of 10% available water deficit treatment, comparable with 30, 50 and 70% available water deficit treatments. Refaie *et al*. (2012) reported that daily watering level at 100% (Etc) optimized cantaloupe total yield, comparable with 80, and 120% of Etc. Moreover, Mirabad *et al*. (2013) reported that cantaloupe fruit yield were 19.6, 28.3 and 30.3 t ha^{-1} at 60%, 80% and 100% ETc, respectively. Additionally, Mani (2014) stated that, under full irrigation regime exhibited the maximum value of cantaloupe yield, which increased by 26.9 and 63.5% more than 70 and 40% deficit regimes. The different yield responses to irrigation, under the cited literatures, may be attributed to different experimentation conditions e.g. soil, varietal effect, prevailing weather and …etc. In the current research trials and on water saving and higher total fresh fruit yield of cantaloupe as well, irrigating cantaloupe crop via 80% ETc regime is preferred instead of 100% ETc regime.

The adopted soil amendment treatments revealed significant differences to influenced total fresh yield of cantaloupe, and (OM + Tafla+ Polymer) resulted in the highest figures reached to 16.36 and 14.77 t/fed, respectively, in the first and second seasons. Shafeek *et al*. (2015) stated that addition of organic manure at a higher level (3.2 ton fed^{-1}) improved fruit yield of cantaloupe plants. In addition, 80% ETc regime as interacted with the soil amendment composed of OM + Tafla+ Polymer revealed the highest values of total fresh yield of cantaloupe comprised 16.27 and 14.87 tonfed^{-1}, respectively, in the first and second seasons.

Table 6. The effect of studied variables on total fruit yield of cantaloupe (t fed^{-1}).

Treatments	2010		2011		2010	2011
	80% ETc	100% ETc	80% ETc	100% ETc	Mean (Soil amendments)	
Control	7.65	7.17	6.25	5.79	7.41 d	6.02 e
OM	12.93	11.91	10.93	10.84	12.42 b	10.88 c
OM + Tafla	10.56	10.28	8.76	8.41	10.82 c	8.59 d
OM + Polymer	14.03	13.68	12.89	12.45	13.85 b	12.67 b
OM + Tafla+ Polymer	16.27	16.45	14.87	14.67	16.36 a	14.77 a
Mean	12.29 a	11.9 a	10.74 a	10.43 a		
LSD 0.05	0.938		0.720		1.653	1.047

Fruit quality (Total Soluble Solids, TSS):

Results in Table 7 showed that, there was a significant effect to increase TSS due to the assessed irrigation rates, and exhibited a reversed response, which increased with lower irrigation rate and vice versa and such trend was true in the first and second seasons. The increases in TSS with 80% ETc regime were 13.26 and 11.39% higher than that with 100% ETc regime, respectively, in the first and second seasons. Such findings are in accordance of Refaie *et al*. (2012) who reported that TSS was increased as daily watering level (Etc) decreased. In addition, Mirabad *et al*. (2013) found that the highest value of sugar content (9.3%) of cantaloupe fruit was attained with 60% ETc, comparable with 80% and 100% ETc. Moreover, Mani (2014) found that, under 40 and 70% deficit regimes TSS (expressed as Brix) value of cantaloupe fruit was increased by 44.4 and 23.8% higher than full regime irrigation (100%).

Table 7. The effect of the studied variables on Total Soluble Solids (TSS) in cantaloupe fruits in 2010 and 2011 seasons.

Treatments	2010		2011		2010	2011
	80% ETc	100% ETc	80% ETc	100% ETc	Mean (Soil amendments)	
Control	11	9.50	11.00	9.83	10.25 b	10.41 b
OM	10	9.16	10.30	9.33	9.58 c	9.91 c
OM + Tafla	11.33	9.83	11.33	10.16	10.58 a	10.58 a
OM + Polymer	10.5	9.66	10.33	9.50	10.08 b	10.00 c
OM+ Tafla+ Polymer	10.66	9.50	10.66	9.33	10.08 b	10.00 c
Mean	10.76 a	9.5 b	10.76	9.66		
LSD, 0.05	0.427		0.210		0.285	0.258

Results in Table 7 indicated that the assessed soil amendment treatments significantly affected TSS values of cantaloupe fruits, and the highest figurers (10.58 and 10.58%) were recorded with OM + Tafla treatment, respectively, in the first and second seasons. The increases in TSS under OM + Tafla treatment amounted to (3.22 and 1.61%), (9.45 and 6.33%), (4.73 and 8.93%) and (4.73and 8.93%) with Control, OM, OM + Polymer and OM + Tafla+ Polymer treatments, respectively, in the first and second seasons. In this sense, Shafeek *et al.* (2015) stated that addition of organic manure at a higher level (3.2 ton/fed.) insignificantly increased TTS fruits. The obtained data also revealed that OM + Tafla treatment as interacted with 80% ETc regime exhibited the highest value of TSS, and that trend was noticed in the first and second seasons.

3. Water relations:

Applied irrigation water (AIW):

Results indicated that, average AIW during 2007 and 2008 seasons were 1342 and 1074 m^3 fed^{-1} for 100% and 80% ETc treatments, respectively. Refaie *et al*. (2012) in 2–season trial under green-house conditions, reported that the applied water for cantaloupe crop ranged 88 – 96.8, 110 – 121 and 132 – 147 $Lplant^{-1}$, respectively, with daily watering levels 80, 100 and 120% (Etc). The present data clear out that the peak of applied water was during fruit formation stage (July) and simultaneously the peak of ETo, regardless the assessed irrigation regime, and that trend was true in the two seasons of study, Figure 1.

Water Use Efficiency (WUE, kgm^{-3})

Results in Table 8 indicated that, water use efficiency (WUE) values were increased with 80% ETc regime by 29.39 and 29.08% in the first and second seasons, respectively, comparable with 100% ETc regime. Such results are in accordance with, Mani (2014) reported that, under 40 and 70% deficit irrigation regimes WUE of cantaloupe fruit was increased by 33.85 and 21.54%, comparable with full regime irrigation (100%). In addition, Mirabad *et al*. (2014) reported that WUE (0.89 t $ha^{-1}cm^{-1}$) for cantaloupe under I_{60} irrigation rate was 45.9% greater than that with I_{100} irrigation one.

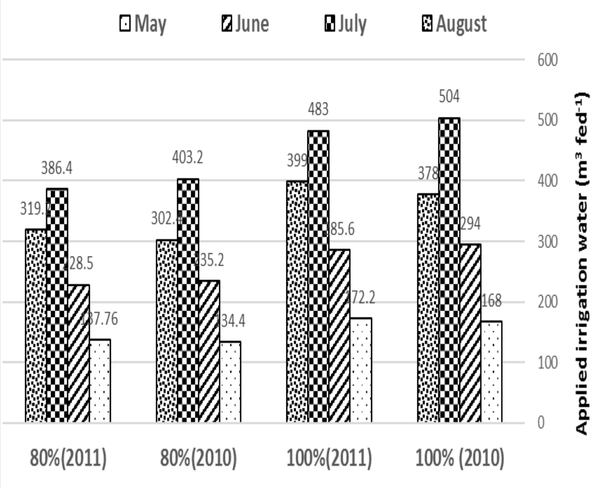

Fig.1:Water applied (m^3fed^{-1}) under 80 and 100% ETc regimes

The obtained results proved that irrigating with 80% ETc and supplying the organic matter +Tafla + polymers as soil conditioners will help obtaining the highest cantaloupe yield in the calcareous soils at Nubaria region under similar conditions

The soil amendment treatment (OM +Tafla+ Polymer) was superior to improve WUE for cantaloupe in comparison with the others soil amendment treatment, where the increases reached to 119.6, 30.7, 56.3 and 18.1% in the first season, and 144.2, 26.3, 71.7 and 16.4% in the second season more than with control, OM, OM +Tafla, and OM + Polymer soil amendment treatments, respectively.

Table 8. Fruit yield, applied water and Water Use Efficiency as affected by studied variables in 2010 and 2011 seasons.

Treatments	Fruit yield ($kgfed^{-1}$)		Applied water (m^3fed^{-1})		WUE (kgm^{-3})		Mean
	80% ETc	100% ETc	80% ETc	100% ETc	80% ETc	100% ETc	(Soil amendments)
Soil amendments			**2010 season**				
Control	7650	7170			7.11	5.33	6.22
OM	12930	11910			12.03	8.86	10.45
OM +Tafla	10560	10280	1075.2	1344	9.82	7.65	8.74
OM + Polymer	14030	13680			13.05	10.08	11.57
OM+Tafla+ Polymer	16270	16450			15.13	12.24	13.66
			2011season				
Control	6250	5790			5.85	4.32	5.09
OM	10930	10840			10.23	8.09	9.16
OM +Tafla	8760	8410	1068.9	1339.8	8.20	6.28	7.24
OM + Polymer	12890	12450			12.06	9.29	10.68
OM+Tafla+ Polymer	14870	14670			13.91	10.95	12.43

CONCLUSION

Based on the obtained results under the conditions of the present this experiment, it is advisable to irrigate cantaloupe crop with amount of water equals to 80% ETc with supplying the soil conditioner composed of (tafla + organic matter + polymer) to gain the highest figures of fruit yield, growth parameters, yield components, as well as fruit quality. In addition, such combination will save irrigation water that could be used in other beneficial conditions.

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إستجابة محصول الكانتالوب ومكوناته وجودة المحصول لكميات الري ومحسنات التربة تحت ظروف الري بالتنقيط في التربة الجيرية.

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أجريت تجربة حقلية في الاراضي الجديدة ذات التربة الجيرية المستصلحة حديثا في محطة بحوث البساتين منطقة النوبارية خلال الموسمين الصيفيين 2010 و 2011. وكان الهدف من هذا البحث هو دراسة تأثير مستويين من الري وخمسة انواع من محسنات التربة على محصول الكانتالوب ومكونات المحصول وجودة الثمار ، كميات الاستهلاك وكفاءة استخدام المياه. استخدم تصميم القطع المنشقة بثلاث مكررات لإجراء التجربة الحقلية. وكانت معاملات الري (100 و 80٪ من البخر نتح للمحصول ، ETc) والتي تمثل القطع الرئيسية، وخمس معاملات من محسنات التربة علي النحو التالي (المقارنة دون أي اضافات للتربة – المادة العضوية (20 م^3 فدان$^{-1}$) – البوليمر (0.1 % بالوزن) + المادة العضوية - الطفلة (0.2 % بالوزن) + المادة العضوية – البوليمر + المادة العضوية + الطفلة) والتي تمثل القطاعات المنشقة وقد أظهرت النتائج الاتي: 1- متوسط طول الفرع وكذا عدد الفروع للنبات كانت اعلي معنويا مع معاملة الري 100% من الاستهلاك المائي (ETc) وكذلك معاملة محسنات التربة (البوليمر + المادة العضوية + الطفلة). 2- متوسط المواد الصلبة الذائبة (TSS%) بلغت اعلي قيمة مع معاملة المحسنات (المادة العضوية + الطفلة) بالمقارنة بالمعاملات الاخري خلال الموسمين ومعاملة الري 80% من الاستهلاك المائي (ETc) 3- بلغ متوسط الانتاج الكانتالوب (طن فدان$^{-1}$) أعلى قيمة في الموسمين على التوالي تحت كمية الري 80٪ ومحستات التربة (المادة عضوية + الطفلة + البوليمر) وكانت هذه القيم 16.36 و 14.77 طن فدان$^{-1}$ في الموسمين 2010 و 2011 على التوالي. 4- كان متوسط كميات مياه الري 1342 و1074 م^3 فدان$^{-1}$ للمعاملات 100 و 80٪ من ال ETcعلى التوالي 5- يمكن تلخبص ما سبق في ان اعلي محصول من الكانتالوب تحت ظروف المنطقة والاراضي الجيرية يكون مع معاملة الري 80% من الاستهلاك المائي (ETc) وإضافة محسنات التربة (البوليمر + المادة العضوية + الطفلة) وذلك للحصول أعلى ناتج من الثمار وقيم عالية للجودة ومكونات المحصول وكذا أفضل إنتاجية لوحدة المياه من محصول الكانتالوب.