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Yield and Quality Performance of Some New Sweet Melon Lines Under Water Stress Conditions

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ABSTRACT: sweet melon is an important crop in Egypt in terms of cultivated area, total production, and consumption, whether domestic or export, in addition to its high nutritional value and high water content. One of the main reasons that hinder the horizontal agricultural expansion is the shortage of irrigation water. Therefore, this study was conducted under the drip irrigation system to legalize the use of irrigation water and increase water use efficiency through evaluating the number of sweet melon inbred lines that could maintain an acceptable level of productivity and quality characteristics under water shortage conditions. Seven inbred lines (genetic material) of sweet melon named: New Matrouh line (L1), Mass Matrouh line (L_2) as a local ecotype, orange line (L_3), Sandafa line (L_4) as a local ecotype, Primal line (L_5), Ideal line (L_6) and Kooz Assal Assuit line (L_7) as a local ecotype were planted under drip irrigation system during the summer seasons of 2017 and 2018. The experiment took place at the Experimental Farm, Faculty of Agriculture, Saba-Basha, Alexandria University, Egypt. Three irrigation rate treatments (40%, 70%, and 100% of $ET_{0)}$ were performed. The gained results revealed that the best results for plant length (cm) trait were achieved with the treatment of 100 % of evapotranspiration. Many branches/plant traits scored the highest mean values with the treatment of 40 % of evapotranspiration. Total fruit yield/plant (kg) character and its component traits [no. of fruits/plant and average fruit weight (g)] were significantly affected by both studied variables (sweet melon genotypes and irrigation rates). As for the main effect of irrigation rates on total fruit yield/plant (kg) and its component traits, there is a significant and direct proportional relationship between the independent variable (irrigation rates) and dependent one (studied characters) during the two studied seasons. The significantly highest mean values for total fruit yield/f were scored at 100 % of irrigation rate during the two seasons, followed with the treatment 70 % of irrigation rate; while 40 % of irrigation rate treatment possessed the lowest mean values in this respect. Most studied fruit characteristics were not significantly affected by different tested irrigation rates from 100% down to 70%. The significantly lowest values for fruit characteristics were scored at 40% irrigation rate treatment. The results of the irrigation water use efficiency (IWUE) of the tested lines proved that the line Ideal (L_6) is the best line under the conditions of irrigation shortage supply. Through the gained results over the two seasons of this investigation, it is recommended to select the inbred line "Ideal" (L_6) because it is characterized by high productivity (kg/plant) at 100% irrigation rate or when there is a shortage of water supply (70% or even 40% of evapotranspiration) compared with other tested sweet melon genotypes; In addition to, its distinctiveness, to some extent, in their fruit characteristics.

Keywords: Sweet melon, inbred lines, water stress, irrigation rate, and irrigation water use efficiency (IWUE).

INTRODUCTION

Melon (*Cucumis melo*, L.), or sweet melon 2n = 2X = 24, is considered one of the most important crops of the *cucurbita* family, which enjoys a high market and export value **(Naroui *et al.*, 2015).** Like many fruits and vegetables, melon is mostly water. One cup of fresh melon has 144 calories, 6% of your daily serving of fiber, zero fat, and cholesterol. Also provides 100% of the daily value for vitamin C, a powerful antioxidant that keeps the cells from damage. Melon contains vitamin

A, which keeps the eyes, skin, bones, and immune system healthy. It also contains about 12% of recommended daily potassium, important for your heart, muscles, and blood pressure. Melon is also full of vitamins and minerals like folic acid, calcium, zinc, copper, and iron **(Abdel-Aziz and Sadik, 2017 and Tabassum *et al*., 2021).** The area cultivated locally in Egypt with cantaloupe and melon reached in the year 2019, 67836 fed. with a total production of 742570 tons with an average production of about 10.4 tons / fed. Most of this area is in newly reclaimed lands, which suffer greatly from the shortage of irrigation water, whether in terms of quality or quantity. Concerning the global cultivated area with all types of melon was 2569180 fed. with the average total productivity of 27501360 tons with average productivity of 10.7 tons/fed **(FAOSTAT, 2020).**

Many studies showed that there were significant increases in root length and decrease in shoot length under drought stress **(Turkan *et al.,* 2004).** It is recognized that photosynthetic efficiency is the first physiological target of environmental stress, such as high temperatures, lack of water in the soil, and salinity **(Liu and Huang 2008).** Biotic and abiotic stresses are the most important factors that severely limit plant growth and metabolism **(Makbul *et al.,* 2011 and Giordano *et al*., 2021).** A large proportion of cultivated land in the world is affected by poor quality or scarcity of water in the first place**.** Water scarcity is a major limiting factor in crop production **(Wahb-Allah *et al.,* 2011)**. Tolerance of drought is an important trait that has a linkage with yield and its components, so to improve this trait, underwater stress requires fundamental changes in the set of relevant attributes, finally emerging as something named drought tolerance **(Maleki *et al.,* 2013).** Hence, the outstanding performance in light of the low amount of water is necessary to sustain the increasing demand in food production in many regions in the world. The future of irrigated agriculture poses the need to develop irrigation strategies using saline and deficit irrigation water to fulfill the food and fiber production gap, to ensure long-term sustainability in irrigated agriculture **(Kuşçu *et al.,* 2015 and Kapoor *et al*., 2020).** In general, melon is known to be moderately resistant to drought. It has been shown that drought stress causes several types of damage such as growth inhibition**.** Therefore, this investigation is concerned to evaluate new sweet melon inbred lines, aiming at the possibility of expanding sweet melon cultivation in areas where is a shortage of irrigation water capable of meeting the growing needs for sweet melon, whether in the local or foreign markets.

MATERIALS AND METHODS

Location and date of the experiment

This experiment was carried out during two successive summer seasons of 2017 and 2018, at the Experimental Farm, Faculty of Agriculture, Saba-Basha, Alexandria University, Alexandria, Egypt. Sowing was accomplished on the 1st of April and 15th of March for the summer seasons 2017 and 2018, respectively.

Genetic material source

Seven inbred lines of sweet melon (*Cucumis melo*, L., 2n=2 X =24) named as; New Matrouh line (L_1), Mass Matrouh line as a local ecotype (L_2), orange line (L_3), Sandafa line as a local ecotype (L_4), Primal line (L_5), Ideal line (L_6) and Kooz Assal Assuit line as a local ecotype (L_7). The previously mentioned inbred lines were kindly supplied by the breeding program for Improving the *Cucurbitaceae* Vegetables Project, Horticultural Research Institute, Agriculture Research Center, Egypt.

The soil of the experimental site

Some physical and chemical analyses of the experimental soil are presented in Table 1. Soil analysis demonstrated that the experimental soil has a sandy clay loam texture.

Table (1). Some physical and chemical properties of the experimental soil for the summer season in 2017.

Particle distribution							
Sand %	Silt %	Clay %	Texture class	pH (1:1, water suspension)	EC (dS/m^{-1}) (1:1, water extract)	O.M. %	Total $CaCO_3$ %
55.9	20.4	23.7	Sand Clay Loam	7.8	0.44	0.30	32.0

Chemical analyses						
Soluble cations (meq/L)				Soluble anions (meq/L)		
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
1.70	2.04	1.30	0.19	5.45	1.48	0.19

Nutrient available (mg kg^{-1})		
KCl-extractable (N)	$NaHCO_3$ extractable (P)	NH_4-Ac-extractable (K)
116.3	21.0	430.0

Agricultural operations:

Seeds were sown on 209 cells tray on 1st April and on 15th March of seasons 2017 and 2018, respectively. Seedlings were transplanted 23-25 days after sowing. Two seedling were planted in each hole in terraces with a width of 1.5 m and a length of 30 m . After 35 days of planting the plants were thinned so that each hole became one plant, the experiment has been cultivated in three replicates, each replicate containing fifteen plants. Phosphorus fertilizer was applied at the rate of 150 kg/fed. in the form of mono-calcium phosphate (15.5 % P_2O_5) at soil preparation, plus 5 tons/fed. of compost were added. Nitrogen fertilizer was applied throughout the drip irrigation system at the rate of 50 kg N/fed. in the form of ammonium sulfate (21.0% N) after 30 days of planting. Potassium fertilizer was added at the rate of 50 kg K /fed in the form of potassium sulfate (48% K_2O) throughout the drip irrigation system. The total amount of drip irrigation at different treatments was calculated. The irrigation numbers, the time, and the water quantity (m^3); in every irrigation, are expressed in terms of time based on the rate of water flow through the drippers (4L/h.).The common cultural practices were carried out according to the recommended practices for commercial sweet melon production in the area.

Irrigation regime

A drip irrigation system was designed for the experiment. Distribution lines consisted of PVC pipe manifolds for each plot. The diameter of the polyethylene laterals was 16 mm and each lateral irrigated one plant row. The inline emitter discharge rate was 4 L h^{-1}.

The values of reference evapotranspiration (ET_0) were calculated using the Penman-Monteith method (Allen *et al.*, 1998) with climatic conditions (Table 2) obtained for the experimental site (NASA, 2021) according to the following equation (Eq. 1):

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{(T+273)} U_2 (e_s - e_a)}{\Delta + \gamma(1+0.34U_2)}$$

Where:

ET_0	Reference evapotranspiration, mm day^{-1}
R_n	Net radiation at the crop surface, MJ m^{-2} day^{-1},
G	Soil heat flux density, MJ m^{-2} day^{-1}, Generally very small and assumed to be zero).
T	Mean daily air temperature at 2.0 m height, °C,
U_2	Wind speed at 2 m height, m s^{-1},
e_s	Saturation vapor pressure at 1.5 to 2.5m height, kPa,
e_a	Actual vapor pressure at 1.5 to 2.5m height, kPa,
$e_s - e_a$	Saturation vapor pressure deficit, kPa,
Δ	Slope vapor pressure curve, kPa°C^{-1},
γ	Psychrometric constant, kPa°C^{-1}.

Table (2). Some climatic conditions of the experimental site during the 2017 and 2018 growing seasons

Month	Pe Mm	U_2 m/s	RH_m %	T_{dew} C°	T_x C°	T_n C°	T_m C°	P kPa	RA MJ/m^2/day	ET0 mm/season
2017 Growing season										
April	51.51	3.98	69.61	12.37	21.32	15.66	18.22	101.52	36.59	173.17
May	0.05	3.81	68.43	15.43	24.92	19.07	21.78	101.33	39.98	228.39
June	4.09	3.83	67.59	18.01	27.68	22.14	24.66	101.18	41.19	208.96
2018 Growing season										
March	2.04	4.03	63.94	11.19	21.66	15.23	18.19	101.34	32.79	116.05
April	2.68	3.67	66.90	13.29	23.03	16.82	19.61	101.32	36.56	206.14
May	0.00	3.93	69.26	16.93	25.90	20.34	22.84	101.05	39.96	236.28
June	0.01	3.65	65.98	18.69	28.25	23.01	25.48	101.02	41.19	227.63

The crop evapotranspiration (ETc) is the daily use of water by sweet melon and calculated using the following equation (Allen *et al.*, 1998), Eq. 2:

$$ET_c = K_c \times ET_0$$

Where:

K_c is the crop coefficient

The crop coefficient (K_c) values for different growth stages of the sweet melon (Allen et al., 1998) are shown in Table (4).

Table (3). Crop coefficient of sweet melon according to the growth stages

Growing stage	Kc value
Initial stage	0.50
Mid-stage	1.05
End-stage	0.70

The crop water requirements were calculated according to the Penman-Monteith equation (Allen *et al*., 1998) using the following equation (Cuenca, 1989), Eq. 3:

$$ET_{drip} = K_r \times K_c \times ET_0$$

ET_{drip} is the crop water requirements under the drip irrigation system.
K_r is the reduction factor that reflects the percentage of irrigation treatments.

Irrigation water – use efficiency or water productivity (IWUE):

Irrigation water–use efficiency (IWUE) or water productivity (WP) was calculated as kg of fruits fresh weight yield produced per one cubic meter of applied water (Doorenbos and Kassem, 1979; Ahmed, 1987 and Sharma *et al*., 2015), Eq.4.

$$\text{IWUE (kg/m}^3\text{)} = \frac{\text{Total fruit yield (kg/fed)}}{\text{Applied irrigation water (m}^3\text{/fed)}}$$

Measurements and data recorded

The plant measurements were recorded for vegetative characters, flowering date, and maturity date; average plant length (cm), the average number of branches/plant, flowering date (days), and fruit maturity date (days). The yield and yield components as total fruit yield/plant (kg), number of fruits/plant, and average fruit weight/plant (g) were recorded. The fruit characteristics such as fruit shape index were calculated as reported by Winiger and Ludwing (1974). Placenta hardness is graded on a scale from 1 to 10; whereas 1 denotes the soft placenta hardness and 10 refers to the extremely placenta hardness. Fruit netting degree: was graded on a scale from 1 to 10; 1 denotes the extremely smooth fruit skin, while 10 denotes the heavily rough skin fruit. Fruit skin color: was graded on a scale from 1 to 10; 1 denotes green skin, while 10 denotes yellow skin. Fruit total soluble solids (T.S.S.) were determined using the Zeiss hand refractometer and fruit moisture content was determined by oven drying.

Experimental design and statistical analysis

The experimental design was presented as a split-plot design with three replicates. Three irrigation rate treatments are named: I_1 (40% of the ET_0), I_2 (70% of The ET_0), and I_3 (100% of the ET_0) were assigned in the main plots, whereas, seven sweet melon genotypes were, randomly, distributed in the sub-plots. The collected data from the experiment were statistically analyzed using the analysis of variance method (Statistix, 2010). Comparisons among the means of different clones were carried out, using the Least Significant Differences (LSD) test procedure at $p \leq 0.05$ level of probability, as explained by using **Snedecor and Cochran (1980).**

RESULTS AND DISCUSSION

1. Mean performances of the vegetative growth parameters, flowering and fruiting duration of sweet melon genotypes

The results presented in Table (4) are the averages of plant length, the number of main branches/plant, flowering, and fruiting duration as affected by sweet melon genotypes, irrigation rates (% ET_0), and their combinations during the first and second seasons (2017 and 2018).

By comparing the performance averages of different traits it can be cleared that plants treated by irrigation rate (I_3) and (I_2) scored the tallest plants and highest branches number in the two seasons of study 2017 and 2018. Concerning flowering and fruiting duration irrigation rate (I_1) enhanced the early flowering and reduced maturity duration for fruits (44.28 and 41.85 days) for the first female flower appearance for the two seasons of study 2017 and 2018, respectively and (84.19 and 84.85) days for first fruit was picked for two seasons of the study 2017 and 2018 respectively.

Concerning the performance of lines under study, L_5 had the tallest plants (225.44 cm) in S_1 2017, and L_6 (212 cm) in S_2 2018. L_2 scored the highest branches number (5 and 4.77 branches in the two seasons of study). Regarding the flowering date, L_7 scored the earliest flowering date (with 43.33 days to first flower appearance in S_1 2017) and L_6 (with 41.66 days to first flower appearance in S_2 2018). In the maturity of fruit duration, L_5 had the earliest maturity duration (with 84.66 and 83.88 days to first fruit picked in the two seasons of study). For irrigation rate x Lines interaction, in general, L_4 and L_5 in irrigation rate I_3 (100 % of field capacity) scored the tallest plants in S_1 2017, and L_3 and L_4 in S_2 2018. But in irrigation rate I_1 (40% of field capacity) L_5 had the tallest plant (204.33 cm) in S_1 2017 and L_6 (182 cm) in S_2 2018. L_2 and L_6 in irrigation rate I_2 (70% of field capacity) scored the biggest branches number in S_1 2017, and L_6 in S_2 2018. But in Irrigation rate I_1 (40% of field capacity) L_7 had the highest branches number (4 branches) in S_1 2017 and L_1, L_6, and L_7 (4 branches) in S_2 2018. Regarding flowering date duration trait, L_6 in irrigation rate I_2 (70% of field capacity) had the earliest flowering date (41 days to first flower appears) in S_1 2017, and L_1 in irrigation rate I_3 (100 % of field capacity) had the earliest flowering date (39.33days) in S_2 2018. In the fruiting duration trait, L_1 and L_5 in irrigation rate I_1 (40 % of field capacity) have the earliest fruiting duration in S_1 2017, but L_6 in I_2 (70% of field capacity) has the earliest duration in S_2 2018 Generally, the obtained data of Table (4) indicated that irrigation of the tested lines with the treatment of irrigation rate 40% leads to an early yield during the two study seasons; regardless of its quantity, compared with the other tested treatments of 70% and 100% irrigation rates. Similar results were found by **Sebnem (2012), Tschoeke *et al.*, (2015), Rad *et al.*, (2017) and Giordano *et al*., (2021)** reported that the thirst or scarcity of water increases vegetative growth, such as plant height and the number of branches. Also, it was noticeable that early flowers appeared on plants and the speed of fruit ripening in an attempt for the plant to preserve its genes and pass them on to future generations in the event of exposure to unfavorable conditions. **Seleiman *et al.*, (2021)** observed that the water scarcity in the soil harms the hormonal balance in the plant and causes reduced transfers from root to leaves and the accumulation of some acids in the leaves. It was noticed that increasing the concentration of some ions has a special effect on the activity of enzymes in the plant, therefore, the effectiveness of the dehydrogenase enzyme in the plant decreases when the water in the medium is decreased, this explains the decrease that occurs in the number of branches and the length and vegetative characteristics in general. **Sebnem, (2012), Haitham *et al.*, (2019),** and **Ashraful *et al.*, (2020);** where the authors reported that the performance of genotype differed from one irrigation rate to another because the durability of water scarcity varies from one genotype to another and this often may be largely due to hereditary reasons. The growth reduction that followed drought stress may be taken place to a massive and irreversible expansion of stomatic cells produced by less meristematic divisions, inhibition of cell expansion. It is well-known water stress resulted in less water content in tissues, which less in the turgor pressure of the cell, and the expansion of the cell, producing a decline in plant progress **(Shao *et al*., 2007).**

Table (4). Averages of the vegetative growth characters, flowering and fruiting duration of seven sweet melon genotypes as affected by three irrigation rates during two successive seasons of 2017 and 2018

Seasons	**2017**				**2018**			
	Vegetative measurements		**Flowering and fruiting duration**		**Vegetative measurements**		**Flowering and fruiting duration**	
Treatments	**plant length (cm)**	**No. of branches/ plant**	**Days for first female flowering (days)**	**Fruit maturity (days)**	**plant length (cm)**	**No. of branches/ plant**	**Days for first female flowering (days)**	**Fruit maturity (days)**
				Irrigation rates				
40% (I_1)	184.33^{c}	4.09^{b}	44.28^{b}	84.19^{b}	160.52^{c}	3.76^{b}	41.85^{b}	84.85^{c}
70% (I_2)	211.52^{b}	5.09^{a}	45.23^{a}	87.14^{a}	198.90^{b}	4.95^{a}	44.23^{a}	88.85^{b}
100% (I_3)	231.04^{a}	4.95^{a}	46.04^{a}	88.90^{a}	242.95^{a}	4.76^{a}	45.19^{a}	91.95^{a}
				Genotypes (Sweet melon inbred lines)				
Matrouh (L_1)	195.11^{bc}	4.55^{a}	43.44^{cd}	85.55^{b}	185.44^{b}	4.33^{ab}	43.33^{b}	89.11^{a}
Mass Matrouh (L_2)	213.77^{ab}	5.00^{a}	47.88^{b}	89.00^{a}	195.55^{ab}	4.77^{a}	45.88^{a}	91.11^{a}
orange line (L_3)	188.88^{c}	4.77^{a}	44.33^{c}	90.88^{a}	205.00^{ab}	4.33^{ab}	42.77^{bc}	91.55^{a}
Sandafa (L_4)	213.33^{ab}	4.66^{a}	49.88^{a}	85.88^{b}	204.55^{ab}	3.88^{b}	46.77^{a}	89.22^{a}
Primal (L_5)	225.44^{a}	4.55^{a}	43.44^{cd}	84.66^{b}	198.33^{ab}	4.44^{ab}	42.22^{cd}	83.88^{b}
Ideal (L_6)	213.33^{ab}	4.77^{a}	44.00^{cd}	84.77^{b}	212.00^{a}	4.77^{a}	41.66^{d}	85.11^{b}
Kooz Assal Assuit (L_7)	212.88^{ab}	4.66^{a}	43.33^{d}	86.44^{b}	204.66^{ab}	4.88^{a}	43.66^{b}	89.88^{a}
				Irrigation rates x Genotypes				
I_1×L_1	167.00^{h}	3.66^{c}	43.33^{efg}	83.00^{ef}	150.00^{ij}	4.00^{cde}	39.33^{j}	82.00^{hi}
I_1×L_2	186.66^{fgh}	4.33^{abc}	43.66^{def}	82.00^{f}	146.66^{j}	3.33^{e}	41.00^{g-j}	81.66^{hi}
I_1×L_3	171.66^{gh}	4.33^{abc}	43.33^{efg}	91.33^{ab}	170.00^{gj}	3.66^{de}	40.66^{hij}	88.66^{c-f}
I_1×L_4	188.33^{fgh}	4.00^{bc}	47.66^{bc}	84.33^{ef}	158.33^{hij}	3.66^{de}	42.00^{f-j}	85.33^{f-i}
I_1×L_5	204.33^{def}	3.66^{c}	42.66^{fg}	82.00^{f}	166.66^{g-j}	3.66^{de}	42.00^{f-j}	84.33^{f-i}
I_1×L_6	191.66^{efg}	4.00^{bc}	46.00^{cd}	83.66^{ef}	182.00^{f-i}	4.00^{cde}	44.33^{d-h}	87.66^{d-g}
I_1×L_7	180.66^{fgh}	4.66^{abc}	43.33^{efg}	83.00^{ef}	150.00^{ij}	4.00^{cde}	43.66^{d-i}	84.33^{f-i}
I_2×L_1	205.00^{def}	5.33^{ab}	43.33^{efg}	87.00^{be}	189.66^{eh}	4.66^{bc}	44.66^{dg}	90.33^{be}
I_2×L_2	215.66^{bcde}	5.66^{a}	49.66^{ab}	92.33^{a}	205.00^{def}	5.66^{a}	47.33^{ad}	95.00^{ab}
I_2×L_3	196.66^{ef}	4.66^{abc}	44.33^{def}	90.33^{a-d}	190.66^{e-h}	4.66^{bc}	42.33^{e-j}	91.66^{bcd}
I_2×L_4	205.00^{def}	4.66^{abc}	50.66^{a}	86.33^{def}	182.00^{fi}	4.33^{cd}	48.66^{abc}	89.00^{cf}
I_2×L_5	226.66^{abcd}	4.66^{abc}	44.66^{def}	85.33^{ef}	195.00^{efg}	5.33^{ab}	43.00^{ej}	84.33^{fi}
I_2×L_6	215.66^{bcde}	5.66^{a}	41.00^{g}	83.33^{ef}	210.00^{def}	4.66^{bc}	40.33^{ij}	81.33^{i}
I_2×L_7	216.00^{bcde}	5.00^{abc}	43.00^{efg}	85.33^{ef}	220.00^{cde}	5.33^{ab}	43.33^{e-i}	90.33^{b-e}
I_3×L_1	213.33^{cde}	4.66^{abc}	43.66^{def}	86.66^{cde}	216.66^{cde}	4.33^{cd}	46.00^{b-e}	95.00^{ab}
I_3×L_2	239.00^{ab}	5.00^{abc}	50.33^{a}	92.66^{a}	235.00^{bcd}	5.33^{ab}	49.33^{ab}	96.66^{a}
I_3×L_3	198.33^{ef}	5.33^{ab}	45.33^{cde}	91.00^{abc}	254.33^{ab}	4.66^{bc}	45.33^{c-f}	94.33^{ab}
I_3×L_4	246.66^{a}	5.33^{ab}	51.33^{a}	87.00^{b-e}	273.33^{a}	3.66^{de}	49.66^{a}	93.33^{abc}
I_3×L_5	245.33^{a}	5.33^{ab}	43.00^{efg}	86.66^{cde}	233.33^{bcd}	4.33^{cd}	41.66^{f-j}	83.00^{ghi}
I_3×L_6	232.66^{abc}	4.66^{abc}	45.00^{def}	87.33^{b-e}	244.00^{abc}	5.66^{a}	40.33^{ij}	86.33^{e-h}
I_3×L_7	242.00^{a}	4.33^{abc}	43.66^{def}	91.00^{abc}	244.00^{abc}	5.33^{ab}	44.00^{d-i}	95.00^{ab}

Means followed by the same alphabetical letter within a column for each parameter are not significantly different from each other at the 0.05 level of probability by L.S.D. test procedure.

2. Mean performances of the yield and its component characters of sweet melon genotypes

Mean performances of yield components characters presented in Table (5) from comparing in general between three irrigation rate it can be concluded that plants which treated by irrigation rate (I_2) and (I_3) (70% and 100% from field capacity) scored the highest average fruit weight, fruit number and total fruit yield/plant in two study seasons 2017 and 2018.

Concerning the performance of lines under study, L_6 had the highest average fruit weight, fruit number, and total yield (kg) (720.44 g, 5 fruits, and 3.64 kg) in S_1 2017) and L_6 (777.00 g) for average fruit yield, L_5 (4.88 fruits) for fruits number and L_3 (3.25 kg) for total yield/plant in S_2 2018. Concerning irrigation rate x Lines interaction, in general L_3 in irrigation rate I_3 (100 % of field capacity) scored the highest average fruit yield in S_1 2017 and S_2 2018 (861.66 g and 983.33 g respectively) and L_6 in irrigation rate I_3 (100 % of field capacity) gave the highest fruit number and total fruit yield in S_1 2017, in S_2 2018, L_3 in irrigation rate I_3 scored the highest average fruit weight (983.33 g) and total yield/plant (4.56 kg). for the number of fruits/plant in 2018, L_7 in irrigation rate I_2 and L_5 in irrigation rate I_3 have the highest scored. Leskovar *et al.*, (2001) concluded that plants that are exposed to unusual conditions such as intense lighting, extreme cold, heat severe thirst, drowning, radiation, pollution, whether with toxic gases or an increase in the concentration of a certain gas like ozone, pathogen incidence. All those and other environmental stressors stimulate the production of the so-called active oxygen species. This is responsible for genes present in salt-tolerant plants that are capable of adapting under stress conditions, This explains the superiority of some strains over others under the same stress conditions, for example in Irrigation rate I_1 (40% of field capacity) L_6 had the highest average fruit weight and total yield/plant (kg) (493 g and 2.29 kg in S_1 2017) (513 g and 2.05 kg in S2 2018). L_2 scored the highest fruit number (5 fruits) in S_1 2017 and L_5 (4.33 fruits) in S_2 2018 under the most water-scarce conditions. These results were in harmony with those found by Abd El-Mageeda and Semida (2015) , Widaryanto *et al.,* (2017) and Kapoor *et al*., (2020). The yield and its components are among the traits that are severely affected by the shortage of water, but the comparison between the genotypes in the severity of their tolerance to water scarcity is useful in the different breeding programs that aim to produce strains that can stabilize with economic production under less favorable conditions such as irrigation water shortage. Ghosh *et al*., (2000) explained that the decline happened in total yield due to water stress may be ascribed to the lessening in leaf area due to fewer and small leaves, and the increase in stomatal resistance and gas exchange; along with, the reduction in transpiration ratio, which all resulting in a decline in photosynthesis.

Table (5). Averages of yield and yield components of seven sweet melon genotypes as affected by three irrigation rates during two successive seasons of 2017 and 2018

Seasons	**2017**			**2018**		
	yield components characters			**yield components characters**		
Treatments	**Average fruit weight (g)**	**No. of fruits/ plant**	**Total yield (kg)/ plant**	**average fruit weight (g)**	**No. of fruits/ Plant**	**Total yield (kg)/ Plant**
Irrigation rates						
40% (I_1)	425.42^{c}	4.04^{b}	1.72^{c}	426.19^{c}	3.52^{c}	1.50^{c}
70% (I_2)	660.71^{b}	4.52^{ab}	3.00^{b}	677.38^{b}	4.66^{a}	3.15^{b}
100% (I_3)	753.47^{a}	4.71^{a}	3.57^{a}	850.00^{a}	4.42^{b}	3.69^{a}
Genotypes (Sweet melon inbred lines)						
Matrouh (L_1)	554.77^{de}	4.44^{ab}	2.44^{c}	648.88^{b}	4.00^{bc}	2.67^{bc}
Mass Matrouh (L_2)	631.11^{bc}	5.11^{a}	3.25^{ab}	656.66^{b}	4.33^{ab}	3.00^{ab}
orange line (L_3)	696.11^{ab}	4.00^{bc}	2.87^{bc}	751.66^{a}	4.22^{b}	3.25^{a}
Sandafa (L_4)	617.77^{cd}	3.88^{bc}	2.43^{cd}	626.66^{bc}	3.55^{c}	2.26^{c}
Primal (L_5)	542.22^{e}	5.00^{a}	2.71^{c}	528.33^{d}	4.88^{a}	2.62^{bc}
Ideal (L_6)	720.44^{a}	5.00^{a}	3.64^{a}	777.77^{a}	4.44^{b}	3.08^{ab}
Kooz Assal Assuit (L_7)	530.00^{e}	3.55^{c}	1.96^{d}	568.33^{cd}	4.04^{ab}	2.62^{bc}
Irrigation rates x Genotypes						
$I_1×L_1$	388.33^{ef}	4.33^{a-d}	1.68^{hi}	390.00^{j}	3.33^{ef}	1.28^{h}
$I_1×L_2$	433.33^{ef}	5.00^{ab}	2.16^{gh}	418.33^{hij}	2.66^{f}	1.14^{h}
$I_1×L_3$	476.66^{e}	3.33^{de}	1.60^{hi}	500.00^{ghi}	3.66^{def}	1.82^{gh}
$I_1×L_4$	470.00^{e}	3.33^{de}	1.57^{hi}	400.0^{ij}	3.33^{ef}	1.53^{h}
$I_1×L_5$	363.33^{f}	5.00^{ab}	1.82^{hi}	361.66^{j}	4.33^{b-e}	1.54^{gh}
$I_1×L_6$	493.00^{e}	4.66^{abc}	2.29^{e-h}	513.33^{gh}	4.00^{cde}	2.05^{fgh}
$I_1×L_7$	353.33^{f}	2.36^{e}	0.92^{i}	400.00^{ij}	3.33^{ef}	1.53^{h}
$I_2×L_1$	596.66^{d}	4.66^{abc}	2.82^{d-g}	656.66^{f}	4.33^{b-e}	2.84^{def}
$I_2×L_2$	636.66^{d}	5.00^{ab}	3.19^{b-e}	638.33^{f}	3.66^{def}	3.63^{a-d}
$I_2×L_3$	750.00^{bc}	4.00^{bcd}	3.00^{d-g}	771.66^{de}	4.33^{b-d}	3.35^{bcd}
$I_2×L_4$	626.66^{d}	4.00^{bcd}	2.49^{d-h}	633.33^{f}	3.66^{def}	2.35^{efg}
$I_2×L_5$	600.00^{d}	5.33^{a}	3.21^{b-e}	621.66^{f}	5.00^{abc}	3.10^{cde}
$I_2×L_6$	810.00^{ab}	5.00^{ab}	4.05^{ab}	790.00^{d}	4.33^{b-e}	3.43^{bcd}
$I_2×L_7$	605.00^{d}	3.66^{cd}	2.22^{fgh}	630.00^{f}	5.33^{ab}	3.37^{bcd}
$I_3×L_1$	679.33^{cd}	4.33^{a-d}	2.95^{d-g}	900.00^{bc}	4.33^{b-e}	3.88^{abc}
$I_3×L_2$	823.33^{ab}	5.33^{a}	4.40^{a}	913.33^{bc}	4.66^{a-d}	4.23^{ab}
$I_3×L_3$	861.66^{a}	4.66^{abc}	4.01^{abc}	983.33^{ab}	4.66^{a-d}	3.77^{a-d}
$I_3×L_4$	756.66^{abc}	4.33^{a-d}	3.24^{bcd}	846.66^{cd}	3.66^{def}	3.08^{cde}
$I_3×L_5$	663.33^{cd}	4.66^{abc}	3.11^{c-f}	601.66^{fg}	5.33^{ab}	3.20^{cde}
$I_3×L_6$	858.33^{a}	5.33^{a}	4.57^{a}	1030.00^{a}	5.66^{a}	4.56^{a}
$I_3×L_7$	631.66^{d}	4.33^{a-d}	2.74^{d-g}	675.00^{ef}	4.66^{a-d}	3.14^{cde}

Means followed by the same alphabetical letter within a column for each parameter are not significantly different from each other at the 0.05 level of probability by L.S.D. test procedure.

3. Mean performances of fruit characteristics of sweet melon genotypes

Performances of the plant under different irrigation treatments in fruit measurements are presented in Table (6) from comparing characters performance under the three irrigation rates it can be noticed that plants which treated by irrigation rate (I_3) (100% from field capacity) scored the highest values of all fruit measurements in the two seasons of study 2017 and 2018.

Concerning the Mean performance of lines under study, L_6 had the highest netting degree (8.44) in S_1 2017 and L_5 and L_7 (8.88) in S_2 2018. L_6 exhibited an oval shape index and by that this characteristic is less affected by environmental conditions, it was constant in the two seasons. Most yellow darkness was found in L_6 in S_1 2017 and L_7 in S_2 2018 (9 in two seasons). In total soluble solids, L_5 scored the highest values in two seasons of the study S_1 2017 and S_2 2018 (13.31 and 13.71% respectively), highest moisture content was exhibited by L_6 in two seasons S_1 2017 and S_2 2018 (93.15 and 94.07 respectively). Irrigation rate x Lines interaction, lines which outperformed under the most severe stress conditions (I_1 = 40% from field capacity), were L_4 in fruit netting degree (8.33), L_6 in fruit shape index (1.28), L_1, L_2, and L_4 in skin color (8 degrees for the darkness of yellow color), L_5 in total soluble solids percentage % (12.13) and L_6 in moisture content % (92.3%) on S_1 2017. In S_2 2018, L_5 in fruit netting degree (7.66), L_6 in fruit shape index (1.03), L_7 in skin color and total soluble solids (7.66 and 12.36 respectively), and L_4 in moisture content % exhibited the highest values overall lines on the study, Hence, it can be said that these traits cannot be neglected except for the fruit shape index, as it characterizes the variety or strain and is fairly stable under any circumstances. These results were in disagreement with those found by **Erdem *et al.*, (2001)** and **Erdem and Yuksel (2003)** on watermelon. The authors found a positive relationship between water shortage and traits like total soluble solids content; where the increasing of shortage irrigation water rate led to an increase in the percentage of the total soluble solids (T.S.S.). The results of this study are in agreement with those found by **Ashraful *et al.*, (2020);** where the authors found that the fruit quality characteristics were strongly affected by the shortage of irrigation water rates and also by the increase in the amount of irrigation water. It is necessary to moderate the amount of irrigation water so that an increase will also work to disrupt these characteristics**.** The results of this experiment confirmed that the fruit shape index trait did not affect by the tested water rates as this trait is considered one of the genetic traits that distinguish each genotype and is almost unaffected by the environmental conditions (irrigation water rates) to a large extent; as also illustrated by **Henane *et al.*, (2015)**.

Table (6): Averages of fruit characteristics of seven sweet melon genotypes as affected by three irrigation rates during two successive seasons of 2017 and 2018

Seasons	**2017**					**2018**				
	fruit characteristics					**fruit characteristics**				
Treatments	Fruit netting degree	Fruit shape index	Skin color	T.S.S %	Moisture content%	Fruit netting degree	Fruit shape index	Skin color	T.S.S %	Moisture content%
Irrigation rates										
40% (I_1)	7.14^{b}	1.08^{a}	7.52^{b}	10.45^{c}	90.94^{b}	6.09^{c}	1.01^{c}	6.76^{b}	11.18^{b}	91.41^{b}
70% (I_2)	9.14^{a}	1.06^{a}	8.76^{a}	12.52^{b}	93.40^{a}	8.76^{b}	1.08^{b}	9.19^{a}	12.89^{a}	92.91^{a}
100% (I_3)	9.23^{a}	1.08^{a}	9.28^{a}	13.45^{a}	93.92^{a}	9.23^{a}	1.13^{a}	9.42^{a}	13.06^{a}	93.59^{a}
Genotypes (Sweet melon inbred lines)										
Matrouh (L_1)	7.88^{b}	1.08^{c}	8.55^{a}	12.2^{b}	92.78^{a}	8.11^{ab}	1.15^{b}	8.77^{a}	12.54^{b}	91.87^{c}
Mass Matrouh (L_2)	8.33^{ab}	1.14^{b}	8.33^{a}	12.44^{ab}	92.58^{a}	8.33^{ab}	1.15^{b}	8.55^{a}	12.95^{ab}	92.75^{bc}
orange line (L_3)	8.55^{ab}	1.04^{d}	8.33^{a}	12.27^{b}	92.34^{a}	7.44^{bc}	1.02^{c}	8.77^{a}	13.40^{ab}	92.52^{bc}
Sandafa (L_4)	9.22^{a}	1.02^{d}	8.33^{a}	10.51^{c}	92.75^{a}	6.88^{c}	1.01^{cd}	6.88^{b}	9.92^{c}	93.58^{ab}
Primal (L_5)	8.66^{ab}	1.02^{d}	8.33^{a}	13.31^{a}	92.98^{a}	8.88^{a}	0.97^{d}	8.66^{a}	13.71^{a}	92.16^{c}
Ideal (L_6)	8.44^{ab}	1.21^{a}	9.00^{a}	11.15^{c}	93.15^{a}	7.66^{bc}	1.22^{a}	8.55^{a}	10.78^{c}	94.07^{a}
Kooz Assal Assuit (L_7)	8.44^{ab}	1.01^{d}	8.77^{a}	13.12^{ab}	92.68^{a}	8.88^{a}	0.99^{d}	9.00^{a}	13.35^{ab}	91.55^{c}
Irrigation rates x Genotypes										
$I_1 \times L_1$	6.33^{d}	1.09^{def}	8.00^{a-d}	11.33^{hk}	90.77^{de}	5.33^{gh}	1.06^{e}	6.66^{efg}	11.36^{d-g}	89.38^{f}
$I_1 \times L_2$	6.66^{cd}	1.16^{bcd}	7.33^{cd}	10.26^{jk}l	90.16^{de}	6.00^{fgh}	1.03^{ef}	6.33^{fg}	10.9^{fgh}	90.09^{ef}
$I_1 \times L_3$	7.66^{bcd}	1.02^{eh}	8.00^{ad}	10.10^{kl}	90.05^{e}	6.66^{efg}	0.97^{fgh}	7.00^{d-g}	12.3^{cf}	91.16^{def}
$I_1 \times L_4$	8.33^{abc}	1.03^{eh}	8.00^{ad}	8.70^{m}	91.42^{b-e}	4.66^{h}	0.97^{fgh}	5.66^{g}	9.36^{h}	93.46^{ad}
$I_1 \times L_5$	8.00^{ad}	0.98^{h}	6.33^{d}	12.13^{ei}	90.89^{cde}	7.66^{cde}	0.98f^{gh}	6.66^{efg}	11.53^{dg}	91.9^{be}
$I_1 \times L_6$	6.33^{d}	1.28^{a}	7.66^{bcd}	9.33^{im}	92.30^{a-d}	5.33^{gh}	1.03^{ef}	7.33^{def}	10.46^{gh}	92.84^{ad}
$I_1 \times L_7$	6.66^{cd}	1.03^{eh}	7.33^{cd}	11.33^{hk}	90.99^{cde}	7.00^{def}	0.99^{e-h}	7.66^{def}	12.36^{cf}	91.02^{def}
$I_2 \times L_1$	8.33^{abc}	1.08^{ef}	8.33^{abc}	12.20^{di}	93.50^{ab}	9.33^{ab}	1.24^{b}	9.66^{ab}	13.40^{bc}	92.21^{ae}
$I_2 \times L_2$	9.33^{ab}	1.10^{cde}	8.00^{ad}	12.70^{cg}	93.96^{a}	9.33^{ab}	1.16^{cd}	9.66^{ab}	14.00^{abc}	94.16^{ab}
$I_2 \times L_3$	8.66^{ab}	1.02^{eh}	8.00^{ad}	13.20^{ae}	93.26^{ab}	6.33^{efg}	0.92^{h}	9.33^{abc}	14.36^{ab}	93.24^{ad}
$I_2 \times L_4$	10.00^{a}	1.02^{eh}	8.66^{abc}	11.03^{ijk}	93.01^{abc}	8.66^{abc}	1.02^{ef}	8.00^{cde}	10.03^{gh}	93.38^{a-d}
$I_2 \times L_5$	9.00^{ab}	1.01^{fgh}	9.33^{ab}	13.56^{abc}	93.83^{a}	9.66^{ab}	1.00^{efg}	9.33^{abc}	14.26^{ab}	91.42^{cf}
$I_2 \times L_6$	9.00^{ab}	1.18^{b}	9.66^{a}	11.46^{gj}	93.26^{ab}	8.33^{bcd}	1.22^{bc}	8.33^{bcd}	11.16^{eh}	94.64^{a}
$I_2 \times L_7$	9.66^{ab}	1.02^{eh}	9.33^{ab}	13.50^{ad}	92.97^{abc}	9.66^{ab}	0.99^{eh}	10.00^{a}	13.03^{bcd}	91.34^{c-f}
$I_3 \times L_1$	9.00^{ab}	1.10^{de}	9.33^{ab}	13.06^{bf}	94.06^{a}	9.66^{ab}	1.15^{d}	10.00^{a}	12.86^{be}	94.03^{ab}
$I_3 \times L_2$	9.00^{ab}	1.16^{bcd}	9.66^{a}	14.36^{ab}	93.67^{ab}	9.66^{ab}	1.26^{b}	9.66^{ab}	13.96^{abc}	94.01^{ab}
$I_3 \times L_3$	9.33^{ab}	1.09^{def}	9.00^{abc}	13.53^{ad}	93.72^{a}	9.33^{ab}	1.17^{cd}	10.00^{a}	13.53^{abc}	93.16^{a-d}
$I_3 \times L_4$	9.33^{ab}	1.02^{eh}	8.33^{abc}	11.80^{fi}	93.84^{a}	7.33^{c-f}	1.03^{ef}	7.00^{d-g}	10.36^{gh}	93.76^{abc}
$I_3 \times L_5$	9.00^{ab}	1.07^{efg}	9.33^{ab}	14.23^{ab}	94.23^{a}	9.33^{ab}	0.94^{gh}	10.00^{a}	15.33^{a}	93.16^{ad}
$I_3 \times L_6$	10.00^{a}	1.17^{bc}	9.66^{a}	12.66^{ch}	93.88^{a}	9.33^{ab}	1.41^{a}	10.00^{a}	10.73^{fgh}	94.73^{a}
$I_3 \times L_7$	9.00^{ab}	0.99^{gh}	9.66^{a}	14.53^{a}	94.07^{a}	10.00^{a}	0.98^{fgh}	9.33^{abc}	14.66^{ab}	92.29^{ae}

Means followed by the same alphabetical letter within a column for each parameter are not significantly different from each other at the 0.05 level of probability by L.S.D. test procedure.

4. Water requirements

The crop water requirements of sweet Melon as calculated with the Penman-Monteith method **(Allen *et al*., 1998)** using the local climatic conditions during the growth stages of Melon are presented in Table (7).

The water requirements of Melon were calculated as 3007.1, 2105.0, and 1202.8 m^3/ha in the first season and 2417.3, 1692.1, and 966.9 m^3/ha in the second season corresponding to 100, 70, and 40% of the ET_0, respectively.

According to the obtained data, the late season or maturity stage of sweet melon has the highest water requirements, followed by the fruiting stage. This result may be due to that the maturity stage needs more water for fruit turgidity and maturity.

Table (7): Crop water requirements (m^3/ha) during growth stages of Sweet Melon

2017 growing season			
Irrigation deficit (% of ETo)			
Growth Stages	**100%**	**70%**	**40%**
Initial (Germination)	450.2	315.1	180.1
Development(Vegetative)	699.1	489.4	279.6
Mid (Fruiting)	1298.4	908.9	519.4
Late (Maturity)	559.4	391.6	223.8
Total	3007.1	2105.0	1202.8
2018 growing season			
Irrigation deficit (% of ETo)			
Growth Stages	**100%**	**70%**	**40%**
Initial (Germination)	316.3	221.4	126.5
Development(Vegetative)	579.6	405.7	231.8
Mid (Fruiting)	997.1	698.0	398.9
Late (Maturity)	524.4	367.0	209.7
Total	2417.3	1692.1	966.9

Irrigation Water-Use Efficiency (IWUE)

When water is the limiting factor of crop production, water stress can improve WUE, so that available water is better allocated. Irrigation Water Use Efficiency (IWUE) is calculated as the harvested yield (kg) / amount of irrigation water (m^3) according to the recommendations of the Food and Agriculture Organization (**Doorenbos and Kassam, 1979).** Among the many biotic and abiotic factors, the most important factors affecting productivity as well as the quality of production are the responsible and optimal management of water **(Bhriguvanshi *et al*., 2012 and Tabassum *et al*., 2021).**

The applied irrigation water was accounted as 3112.4, 2178.7, and 1244.9 m^3/ha in the first season and 2659.1, 1861.3, and 1063.6 m^3/ha in the second season for 100, 70, and 40% of the ET_0 irrigation treatments, respectively.

The data of irrigation water-use efficiency (IWUE) is presented in Table (8). The results indicated that IWUE was significantly affected by irrigation levels, in which the recorded values increased with decreased irrigation levels. The irrigation level of 2178.7 and 1861.3 m^3/ha (70% of ET_0) in the two seasons possessed the highest values of IWUE (29.29 and 39.85 kg/m^3, respectively). As seen from Table (8), the IWUE ranged between 24.19 and 29.29 kg/m^3 in the first season and between 32.19 and 39.85 kg/m^3 in the second season. Decreasing the irrigation water level resulted in a significant effect on IWUE.

In addition, IWUE was significantly ($p<=0.05$) affected by sweet Melon genotypes (Table, 8). The IWUE ranged between 18.49 and 36.14 kg/m^3 in the first season and between 29.60 and 39.80 kg/m^3 in the second season. The highest values attained for line L_6 in both seasons and the lowest values attained with line L_7 in the first season, but L_4 has the lowest value in the second season.

As for the interaction between irrigation water treatments and sweet melon genotypes, the obtained data of Table (8) showed that IWUE was significantly affected ($p \leq 0.05$) with these two independent variables during the two study seasons. The L_6 and L_3 genotypes with 70% of ET_0 significantly gave the highest IWUE (39.58 kg/m^3) in the first season. The line L_2 gave the highest value of IWUE (45.88 kg/m^3) followed by the line L_6 which gave 43.35 kg/m^3 for the IWUE in the second season. The high values for the IWUE regarding line L_6 under water shortage conditions during the two study seasons could be attributed to the effect of the genotypic characteristic of this line.

The lower values of IWUE for the deficit irrigation treatment may be due to the lower values of sweet melon yield in both seasons. It can be concluded that sweet Melon is sensitive to water stress.

Table (8). Gross yield and Irrigation Water-Use Efficiency (IWUE) of Sweet Melon as affected by irrigation deficit, genotypes, and their interactions.

Treatments		Total Yield	IWUE (kg/m^3)	Total Yield	IWUE (kg/m^3)
		2017		2018	
Irrigation rates (% of ET_0)					
40% (I_1)		37.84 c	28.47 a	34.22 c	32.80 b
70% (I_2)		65.94 b	29.29 a	69.36 b	39.85 a
100% (I_3)		78.63 a	24.19 b	81.27 a	32.19 c
Genotypes					
Matrouh (L_1)		54.63 cd	25.11 b	58.67 d	32.23 e
Mass Matrouh (L_2)		71.50 ab	32.24 a	66.00 c	35.59 b
orange line (L_3)		63.14 bc	27.65 b	67.83 b	40.15 a
Sandafa (L_4)		53.53 d	24.08 b	51.04 f	29.60 f
Primal (L_5)		59.69 cd	27.52 b	57.49 e	33.18 d
Ideal (L_6)		80.00 a	36.14 a	71.35 a	39.8 a
Kooz Assal Assuit (L_7)		43.12 e	18.49 c	58.96 d	34.07 c
Irrigation rates X Genotypes					
40%	**L_1**	36.96 hi	27.81 de	28.16 p	26.99 m
	L_2	47.52 fghi	35.75 abc	25.08 q	24.03 m
	L_3	35.20 hij	26.48 def	40.04 n	38.37 f
	L_4	34.54 ij	25.99 def	33.66 o	32.26 j
	L_5	40.04 ghi	30.12 cd	33.88 o	32.47 j
	L_6	50.38 defgh	37.91 ab	45.10 m	43.22 bc
	L_7	20.24 j	15.23 h	33.66 o	32.26 j
70%	**L_1**	64.04 bcdef	27.56 de	62.48 k	35.89 h
	L_2	70.18 bc	31.17 bcd	79.86 e	45.88 a
	L_3	66.00 bcd	39.58 a	73.70 g	42.34 d
	L_4	54.78 cdefg	24.33 defg	51.70 l	29.70 k
	L_5	70.62 b	31.37 bcd	68.20 ij	39.18 e
	L_6	89.10 a	39.58 a	75.46 f	43.35 b
	L_7	48.84 efghi	21.69 efgh	74.14 g	42.59 cd
100%	**L_1**	64.90 bcde	19.96 fgh	85.36 c	33.81 i
	L_2	96.80 a	29.78 cd	93.06 b	36.85 g
	L_3	88.22 a	27.14 de	100.32 a	39.73 e
	L_4	71.28 b	21.93 efgh	67.76 j	26.84 m
	L_5	68.42 bc	21.05 efgh	70.40 h	27.88 l
	L_6	100.54 a	30.93 bcd	82.94 d	32.85 j
	L_7	60.28 bcdef	18.54 gh	69.08 i	27.36 lm

Means followed by a similar letter within a column for each parameter are not significantly different from each other at the 0.05 level of probability by L.S.D. test procedure.

Thus, the main concern of deficit irrigation is that it maximizes water productivity, although some reduction in yields is observed. In regions where water is the limiting factor for crop production, maximizing water productivity by deficit irrigation is often more economically profitable for a farmer than maximizing yield.

Results of irrigation water use efficiency (IWUE); which were presented in (Table, 8), the importance of water deficit to obtain high yields and better usage of water, and this can be mainly attributed to adequate and homogeneous moisture distribution in the root zone in improving crop resistance to water stress **(Abdelhamid *et al*., 2013** and **Rahimizadeh *et al*., 2007).**

Increases in water productivity under insufficient irrigation can be attributed to several reasons, one of which is that the negative effect of drought stress during certain growth stages on the division of biomass between reproductive and vegetative biomass (harvest index) is reduced **(Fereres and Soriano, 2007; Reynolds and Tuberosa, 2008)** due to increased reproductive organs **(Karam *et al*., 2014).** In this respect, **Steduto *et al*., (2007)** stated that increasing water production for net assimilation of biomass while relieving drought stress or increased crop hardening occurs due to the conservative behavior of biomass growth in response to transpiration. Water productivity for the net assimilations of biomass is increased due to the synergy between irrigation and fertilization **(Steduto and Albrizo, 2005)**. Negative agronomic conditions are avoided during crop growth, such as pests, diseases, anaerobic conditions in the root zone due to waterlogging **(Pereira *et al*., 2002; Geerts *et al*., 2008 and Tabassum *et al*., 2021).**

CONCLUSION

water stress is referred to as a limited water supply to plant roots, which reduces the rate of transpiration in plants. It is mainly caused by a water deficit as a result of drought conditions. The thirst or scarcity of water increases vegetative growth, such as plant height and the number of branches. Also, it was noticeable that early flowers appeared on plants and the speed of fruit ripening in an attempt for the plant to preserve its genes and pass them on to future generations in the event of exposure to unfavorable conditions. Yield and its components are among the traits that are severely affected by the shortage of water, but the comparison between the genotypes in the severity of their tolerance to water scarcity is useful in the different breeding programs that aim to produce strains that can stabilize with economic production under unfavorable conditions such as lack of irrigation water. Fruit quality is strongly affected by the shortage in the amount of water and also by the increase in the amount of irrigation water, it is necessary to moderate the amount of irrigation water so that an increase will also work to disrupt these characteristics**.** There are characteristics such as the fruit shape index that are not affected by the amount of water as it is one of the characteristics of the variety.

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الملخص العربي

إنتاجية وجودة أداء بعض سلالات الشمام الجديدة تحت ظروف الإجهاد المائى

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يعتبر الشمام محصولاً مهماً في مصر من حيث المساحة المزروعة وإجمالي الإنتاج والاستهلاك سواء محلياً أو للتصدير بالإضافة إلى قيمته الغذائية العالية ومحتواه المائي العالي. من الأسباب الرئيسية التي تعيق التوسع الزراعي الأفقي هو نقص مياه الري. لذلك أجريت هذه الدراسة تحت نظام الري بالتنقيط لتقنين استخدام مياه الري وزيادة كفاءة استخدام المياه من خلال تقييم عدد من سلالات الشمام التي يمكن أن تحافظ على مستوى مقبول من الإنتاجية وخصائص الجودة في ظل ظروف نقص المياه. سبعة سلالات مرباة داخليا (المادة الوراثية) من الشمام تسمى: السلالة مطروح الجديدة (L_1) ، السلالة مص مطروح "سلالة محلية" (L_2) ، السلالة البرتقالي (L_3) ، السلالة صندفا "سلالة محلية" (L_4) ، السلالة بريمال (L_5) ، السلالة إيديال (L_6) ، السلالة كوز عسل أسيوط "سلالة محلية" (L_7) تم زراعتها تحت نظام الري بالتنقيط خلال موسمي الصيف 2017 و 2018. أجريت التجربة في المزرعة البحثية ، كلية الزراعة ، سابا باشا ، جامعة الإسكندرية ، محافظة الإسكندرية ، مصر. تم تنفيذ ثلاث معدلات لمياه الري (40٪ ، 70٪ و 100٪ من البخر – نتح). أهم النتائج المتحصل عليها تتلخص في الآتي: أظهرت النتائج المكتسبة أن أفضل النتائج بالنسبة لصفة طول النبات (سم) قد تحققت من خلال معاملة الرى 100٪ من البخر – نتح , صفة عدد الأفرع الرئيسية / النبات سجلت أعلى متوسط قيم مع معاملة الرى 40٪ من البخر – نتح, صفة المحصول الكلى من الثمار / النبات (كجم) و صفات مكونات المحصول [عدد الثمار / نبات ، ومتوسط وزن الثمرة (جم)] تأثروا معنويا بكلا المتغيرين المدروسين (التراكيب الوراثية للقاوون ومعدلات الري). بالنسبة للتأثير الرئيسى لمعدلات الري على المحصول الكلي من الثمار/ نبات (كجم) و صفات مكونات المحصول ، فهناك علاقة تناسبية معنوية ومباشرة بين المتغير المستقل (معدلات الري) والمتغير التابع (الصفات المدروسة) خلال موسمي الدراسة. أيضا سجلت أعلى قيم معنوية لصفة المحصول الكلى من الثمار / النبات مع معاملة الرى عند 100 ٪ من البخر – نتح ، تلاها معاملة الرى عند 70٪ من البخر – نتح خلال الموسمين ، بينما معاملة الرى عند 40٪ من البخر – نتح فقد أعطت أدنى متوسط قيم فى هذا الصدد , كما أنه لم تتأثر معظم الخصائص المدروسة للثمار معنويا بمعاملات الري المختلفة المختبرة بدءا من الرى عند 100٪ من البخر – نتح نزولا إلى الرى عند 70٪ من البخر – نتح. ثبت من نتائج كفاءة السلالات المختبرة لإستخدام مياه الرى أن السلالة إيديال (L_6) هى الأفضل تحت ظروف نقص امدادات مياه الرى. يوصى البحث ، من خلال النتائج المكتسبة على مدى الموسمين ، باختيار السلالة إيديال (L_6) لأنها تتميز بإنتاجية عالية (كجم / نبات) سواءا مع معاملة الرى عند 100٪ من البخر – نتح أو عند وجود نقص فى إمدادات مياه الرى (الرى عند 70٪ أو حتى عند 40٪ من البخر النتح) مقارنة بالسلالات المختبرة الأخرى من الشمام ، بالإضافة أيضا إلى تميزها ، إلى حد ما ، في خصائصها الثمرية.