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EFFECT OF IRRIGATION WATER REGIME ON NAVEL ORANGE YIELD, FRUIT QUALITY AND SOME WATER RELATIONS IN THE NORTH MIDDLE NILE DELTA REGION

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ABSTRACT

A field experiment was carried out during the two successive growing seasons 2009/2010 and 2010/2011at a private orchard located at, Motobus, Kafr El Sheikh Governorate, Egypt, on twenty years old Navel orange (*Citrus sinensis,* Osbeck) to study the impact of irrigation treatments on Navel orange yield, quality and some water relations in the North Nile Delta region. They were budded on Sour orange (*Citrus aurantium* L.) rootstock spaced at 5 x 5 metre apart. The orchard soil is clayey. The trees were selected in a good health condition and uniform in both vegetative growth and fruit load. The experimental design used in this present study is a randomized complete block design with five replicates. Fifteen trees were selected in this study and divided randomly into three groups; each group was subjected to one of the following irrigation treatments: I_0 (Traditional irrigation, (control) treatment like local farmers practiced in the studied area (16 irrigations through the whole growing season), I_1 (giving 12 irrigations through the whole growing season) and I_2 (giving 8 irrigations through the whole growing season, which represents stressed conditions on plants).

The highest values fruit set%: fruit weight (g) and yield as kg/tree for the two studied parameters were recorded under irrigation treatment I_2 comparing with the other irrigation treatments I_0 and I_1.

Obtained data in the two growing seasons showed that the highest values for irrigation water applied were recorded under irrigation I_0 comparing with other irrigation treatments I_1 and I_2 in the two growing seasons and the values are 7500, 5250 and 4150 m^3/fed. For water applied as the mean values of first and second growing seasons, respectively. On the contrary, the lowest values for water applied were recorded under irrigation treatment I_2 in the two growing seasons.

The highest values PIW (Productivity of irrigation water (kg m^{-3})) and PW (water productivity (kg m^{-3})) for the two studied parameters were recorded under irrigation treatment I_2 comparing with the other irrigation treatments I_0 and I_1. Generally, the values of the two studied parameters can be descended in order $I_2 > I_1 > I_0$.

Keywords: Navel orange, Productivity of irrigation water, water productivity

INTRODUCTION

Agriculture is the main sector in water demand at the national level. Water allocation in irrigation is about 85% from the total national water. So, effective management at the irrigation sector is the principal way towards the rationalization policy of the country. In this aspect, effective irrigation management on-farm level becomes a must. One of the main procedures to achieve this target is through how much water should be applied by studying water regime of navel orange through investigation which the suitable number of irrigation that gave the best yield and fruit quality and also makes rationalization for irrigation of this crop. The irrigation custom creates different problems to both soil and cultivated trees caused by soil waterlogging, raising soil water table and pathological disorders. So that, calculating water requirements of the conducted research. The research on citrus irrigation has been reviewed by several authors (Levy *et al* 1978, Garica-Petillo, 1995 and Lal *et al* 1997).

Fruit set percentage and yield as kg/tree of Washington Navel orange increased with irrigation rate (6000 m^3 of water/fed./year).(El-Sabrout and Kassem,2002)

Citrus is one of the most important fruit crops all over the world as well as in Egypt. Citrus fruit considered as the best exportation fruit potential moreover it is popular fruit in Egypt because of its nice low price and nutritive value. Many food industries such as juice, jam, pectin, citric acid and oil with its aromatic pharmaceutical uses, have been built on citrus production. Citrus fruit occupy the first rank among economic fruit crops in Egypt as well as all over the world. Orange is the most important citrus crop in Egypt. Navel orange is the leading variety followed by Valencia, local Balady, acidity lees (saccharine) and other varieties which are also produced locally. Navel oranges enjoy the most significant importance for local market and also for export markets. Making control on amount of irrigation applied water for trees is very important from the irrigation point of view because careless irrigation has bad effects on both soil properties and also on the cultivated trees productivity and quality as above mentioned. So, the main targets of this present study were to study 1- the influence of the studied water regime on some water relations 2- the effect of water regime on both yield and fruit quality, and 3- the water behaviour of this crop under conditions of the studied area.

MATERIALS AND METHODS

A field experiment was carried out during the two successive growing seasons of 2009/2010 and 2010/2011 at a private orchard located at Ebiana village, Motobus, Kafr El Sheikh Governorate, Egypt, on twenty years old Navel orange (*Citrus sinensis,* Osbeck). Trees were selected in a good health condition and nearly uniform in both vegetative growth and fruit load. Fifteen trees were selected in this study and divided randomly into three groups; each group was subjected to one of the following irrigation treatments:

I_0 = Traditional irrigation, control treatment like local farmers practiced in the studied area, (giving 16 irrigations through the whole growing season),

I_1 = (giving 12 irrigations through the whole growing season) and

I_2 = (giving 8 irrigations through the whole growing season) which represents stress conditions on plants.

Table (1): Mean of some meteorological data for Kafr El-sheikh area during the two growing seasons of 2009/2010 and 2010/2011

Month	Season 2009/2010							Season 2010/2011						
	Air Temp.C°		Relative humidity,%		wind speed , km/ day	Ep,mm/day	rain, mm/month	Air Temp. C°		Relative humidity, %		wind speed , km/ day	Ep,mm/day	Rain, mm/month
	maxi	min.	max	min				max	min	max	min			
Nov.	26.0	10.5	77.7	50.0	58	2.60	----	26.8	11.0	82.0	54.2	63	2.9	------
Dec.	22.2	8.8	76.5	52.0	64.0	2.15	5.8	22.0	8.3	85.0	55.7	58.3	1.9	90.0
Jan.	21.5	7.8	83.5	55.0	53.0	1.9	----	20.3	5.8	84.2	54.0	42.5	2.11	-------
Feb.	24.5	9.4	84.2	55.7	76.8	2.75	32	23.4	7.4	87.0	54.0	64.0	2.7	22.5
Mar-	24.3	10.0	76.3	44.0	110	4.38	----	21.8	6.8	86.3	49.5	77.4	2.5	14.0
Apr-	28.2	11.0	96.0	40.7	96	5.6	-----	26.5	10.0	85.0	47.7	83.7	4.7	----
May-	29.6	14.4	72.6	39.5	96	7.1	-----	29.0	13.0	76.7	38.0	102.0	5.6	-----

*** Source: meteorological station at Sakha 31^{0}-07' N Latitude, 30^{0}-57'E Longitude, N.elevation 6 m.**

The trees were budded on Sour orange rootstock (*Citrus aurantium* L.) spaced at 5 x 5 metre apart. The orchard soil is clayey and its drainage is well, some properties of representative soil are shown in Table (1). The trees received the normal cultural practices usually adapted for this area.

Some physical and chemical properties:

The studied physical properties such as mechanical analysis were determined according to the international pipette method. Soil bulk density, soil field capacity and permanent wilting point were determined according to (Klute, 1986). Available soil moisture was calculated as the difference between the field capacity and permanent wilting point. The studied chemical properties such as organic matter content (OM %) was determined by using Walkely and Black's method (Jackson, 1973). Soil reaction (pH) values were determined in 1:2.5 soil water suspensions (Jackson, 1973). Total soluble salts were measured electrical conductivity (EC) apparatus in the saturated soil paste extract (Jackson, 1973). Soluble Cations and Anions (Ca^{++}, Mg^{++}, Na^{+}, K^{+}, Co_3^{--}, HCo_3^{-}, Cl^{-} and So_4^{--} as meq/L) were determined in soil paste extract (Jackson, 1973). But $So4^{--}$ was calculated by difference. Available nitrogen was determined according to (Jackson, 1973). Available potassium was extracted by 1N ammonium acetate at pH 7 and determined by using Flame photometer according to (Knudsen *et al* 1982).

Table (2): The mean values of some physical and chemical properties of the studied soil.

Soil properties	Soil depth, cm.	
	0-30	30-60
Particle size distribution %		
Sand	8.27	8.23
Silt	39.82	34.10
Clay	51.91	57.67
Texture class	Clayey	Clayey
Bulk density (Mg/m^3)	1.17	1.30
Field capacity%	42	40
Organic matter (O.M %)	2.44	1.41
EC (ds /m)	1.60	1.75
pH(1:2.5)	8.15	8.21
Cations (meq/L)		
K^+	0.14	0.15
Na^+	7.7	7.7
Ca^{++}	3.18	4.24
Mg^{++}	3.96	3.92
Anions (meq/L)		
Cl^{--}	8	11
Co_3^{--}+HCo_3^-	3	3.5
So_4^{--}	3.98	1.51
Available ppm		
N	64.75	59.50
K	358.8	343.2

Data collection:

A. Some water relations:

Water applied

Water applied was computed as described by **Giriappa (1983):**

Wa = IW + Re ……………………………………………… (1)

Where:

IW = Irrigation water delivered

Re = Effective rainfall

Irrigation water delivered

Submerged flow orifice with fixed dimension was used to convey and measure the irrigation water applied, as the following equation (Michael, 1978).

$$Q = CA\sqrt{2gh}$$

Where

Q = Discharge through orifice, ($cm^3\ sec^{-1}$).

C = Coefficient of discharges (0. 61).

A = Cross sectional area of orifice, cm^2.

g = Acceleration due to gravity, cm/sec^2 (980cm/sec).

h = Pressure head, over the orifice center, cm.

Total number of irrigation was events 16, 12 and 8 for treatment I_0, I_1 and I_2, respectively.

2. Water consumptive use:

To compute the actual consumed water of the growing plants, soil moisture percentage was determined (on weight basis) before and after each irrigation as well as at harvesting. Soil sample were taken from successive layers in the effective root zone (0-15, 15-30, 30-45 and 45-60 cm). This is a direct method for calculating water consumptive use based on soil moisture depletion (SMD) or actual crop water consumed (ETc) as stated by Hansen *et al* (1979).

$$Cu = SMD = \sum_{i=1}^{i=4} \{(\theta_2-\theta_1)/100)\} \times Dbi \times Di$$

Where:
Cu = water consumptive use (cm) in the effective root zone of 60 cm depth.
SMD = soil moisture depletion.
I = number of soil layers (1-4)
Di = soil layer thickness (15 cm)
Dbi = Bulk density (Mg/m^3) of the layer
Θ_1 = soil moisture percentage before the next irrigation
Θ_2 = soil moisture percentage 48 hours after irrigation

3. Water productivity:

Water productivity (PW) and productivity of irrigation water (PIW) were calculated according to (**Ali *et al* 2007)** as follows:

PW = Y/Cu and PIW = Y/Wa

Where:
PW = water productivity (kg m^{-3})
Y = marketable yield kg fed^{-1}
Cu = water consumptive use (m^3 fed^{-1})
PIW = productivity of irrigation water (kg m^{-3})
Wa = seasonal water applied (m^3 fed^{-1})

B. Fruit set, pre-harvest drop, yield and fruit quality:

1. Fruit set (%):

Ten branches representing all sides of each experimental tree were chosen at random and labeled before the beginning of treatments. During the flowering on each selected branch the number of leafy inflorescences was born on the tree each season was recorded. During both experimental seasons the percentage of setted fruits were calculated according to the following formula: Fruit set % = (total number of set fruits ÷ total number of flowers at full bloom) ×100

2. Pre-harvest fruit drop (%):

3. Yield:

Fruits were harvested at the same time in the two successive years at mid November. Tree yield was calculated either fruit number or kg/tree.

4. Fruit quality parameters:

4.1. Physical criteria:

• Average of fruit weight (g) was recorded.
• Peel punctures resistance: fruit firmness of the skin was recorded by LFra texture analyzer instrument using penetrating cylinder of 5 mm of diameter to

a content distance 1 cm inside the skin (and penetrating the flesh) using a constant speed at 0-3 mm/sec, and the results were expressed as the resistance force to the penetrating tester in units of pressure gm/cm^2 (Harold, 1985).

4.2. Chemical parameters:

- Soluble solids contents (SSC) percentage was determined by using Carl Zeiss hand refractometer.
- Titratable acidity (citric acid) was determined as % in fresh juice (A O A C 1990).
- Vitamin C. (ascorbic acid) was determined in filtered juice sample and expressed as mg/100 ml juice as described by (A O A C 1990).
- Sugar contents (reducing, non-reducing and total sugars) were determined in fruit juice using the modified method (Shaffer and Hartman, 1921) and (Ranganna, 1979). Sugars content were expressed as g/100g fresh weight of fruit flesh.

Statistical analysis:

Statistical analysis of the studied experiment was randomized complete block design and all data obtained throughout this present work were tested by analysis of variance (Little and Hills 1998). Duncan’s multiple range tests were used to comparison among the treatments means (Duncan 1955).

RESULTS AND DISCUSSION

A- Irrigation parameters:

1- Irrigation water applied (Wa) (m^3/ fed)**:**

Presented data in Table (3) clearly showed that the values of amount of seasonal irrigation water applied were affected by irrigation treatments in the two growing seasons. The highest values were recorded under I_0 (traditional irrigation) and the values are 7400 and 7600 m³/fed./year in the first and second growing seasons respectively. On the other hand, the lowest values were recorded under I_2 (8 irrigation through the whole growing season) and the values are 4200 and 4100 m³/fed./year in the first and second seasons, respectively. Generally, the values of amount of seasonal irrigation water applied can be descended in order $I_0 > I_1 > I_2$ in the two growing seasons. Increasing amount of seasonal irrigation water applied under traditional irrigation comparing with other irrigation treatments might be due to increasing number of irrigation under these conditions. And hence, decreasing irrigating intervals, increased amount of irrigation water comparing with other irrigation treatments. These results are in a great harmony with those obtained by Treeby *et al* (2007) on Navel orange and Cogo- *et al* (2011) on Broccoli

Table (3): Effect of irrigation treatments on amount of seasonal irrigation water applied for Navel orange in the two growing seasons.

Irrigation treatments	2009/2010	2010/2011	Mean of 2 seasons
	Irrigation m³/fed./year	Irrigation m³/fed./year	Irrigation m³/fed./year
I_0	7400	7600	7500
I_1	5200	5300	5250
I_2	4200	4100	4150

2.Water consumptive use (Cu) (m³/ fed):

Data in Table (4) illustrated that the values of consumptive use of Navel orange were affected by irrigation regime under study in the two growing seasons. The highest values for consumptive use were recorded under traditional irrigation (I_0) and the values are 4440 and 4940 m^3/fed. in the first and second growing seasons respectively. On the contrary, the lowest values were recorded under irrigation treatment (I_2) (giving 8 irrigations during the whole growing seasons) in the two growing seasons and the values are 2940 and 2665 m^3/fed. In the first and second growing seasons respectively. The values of Navel orange in the two growing seasons can be descended in order $I_0 > I_1 > I_2$.

Increasing values of consumptive use for Navel orange in the two growing seasons under traditional irrigation (I_0) (control treatment like local farmers practiced) comparing with the other irrigation treatments might be due to increasing amount of irrigation water applied under conditions of this treatment. These results are in a great harmony with those obtained by Perez-Sarmiento *et al* (2010) on Apricot and Bordonaba, and Terry (2010) on Strawberry

Table (4): Effect of irrigation treatments on amount of seasonal water consumptive use for Navel orange in the two growing seasons.

Irrigation treatments	2009/2010	2010/2011	Mean of 2 seasons
	m^3/fed/year	m^3/fed/year	m^3/fed/year
I_0	4440	4940	4690.0
I_1	3640	4095	3867.5
I_2	2940	2665	2802.5

3.Water productivity (PW) and productivity of irrigation water (PIW):

Water productivity was considered as an evaluation parameter of yield per unit of consumed water, i.e. PW is a tool for maximizing crop production per each unites of consumed water. Irrigation Water productivity was considered as an evaluation parameter of fresh water per unite of applied water i.e. PIW is a tool for maximizing crop production per each unite of applied water.

Presented data in Table (5) , the average values of PW in the two growing seasons were 2.75 , 3.52 and 4.1 kg /m^3.While PIW were 1.71, 2.68 and 2.76 Kg/m^3 respectively for treatments I_0 , I_1 and I_3. Generally, as clearly shown the values of water productivity were higher than those of productivity of irrigation water in two growing seasons .Data in the same table also illustrated that the highest values for the both studied parameters were recorded under **I_2** (treatment which exposed to stress) in the two growing seasons .On the contrary, the lowest values were recorded under irrigation treatment I_0. The values of both studied parameters can be descended in order $I_2 > I_1 > I_0$ in the two growing seasons. Increasing values of water productivity comparing with productivity of irrigation water in the two growing seasons might be due to the values of consumptive use were less than the values of applied water as shown in the table (4). Also increasing the values of water productivity and irrigation water productivity in the two growing seasons under irrigation treatment I_2 comparing with the other irrigation treatments might be due to decreasing the values of both consumptive use and irrigation water applied so increasing the values both studied irrigation efficiencies. These results are in a greet harmony with these obtained by Velez *et al* (2007) on citrus Buendía, *et al*. (2008) on peaches.

Table (5): Effect of irrigation treatments on water productivity and productivity of irrigation water (Kg m^{-3}) for navel orange during the two growing seasons.

Treat.	Season 2009/2010					Season 2010/2011					Mean of two season	
	Yield	W a (m^3)	Cu (m^3)	PW	PIW	Yield Kg/fed	W a (m^3)	Cu (m^3)	PW	PIW	PW	PIW
I_0	13052.8	7400	4440	2.94	1.76	12651.2	7600	4940	2.56	1.66	2.75	1.71
1_1	13764.8	5200	3640	3.78	2.65	13324.8	5300	4095	3.25	2.51	3.52	2.58
1_2	11650.6	4200	2940	3.96	2.77	11284.8	4100	2665	4.23	2.75	4.10	2.76

B. Fruit set, pre-harvest drop, yield and fruit quality:

1. Fruit set (%):

Presented data in Table (6) clearly showed that, the mean values of fruit set percentage were affected by irrigation frequency in the two growing seasons. The highest mean values were recorded under irrigation treatment 12 watering throughout growing season in the two growing seasons and the mean values are 8.26 and 6.62% respectively (El-Sabrout and Kassem,2002, of Washington Navel orange)

On the contrary, the lowest mean values were recorded under irrigation treatment 16 watering throughout growing season (control treatment like local farmers practiced in the studied area) and the mean values are 5.97 and 5.95% in the first and second growing seasons respectively. These findings are parallel to those of El-Abd (2005) revealed that decreasing irrigation level had a positive effect on fruit set percent of Washington navel orange trees..

2. Pre-harvest fruit drop %:

Data in Table (6) revealed that the mean values of pre-harvest fruit drop percentage were affected by number of given watering in the two growing seasons. The highest mean values in the two growing seasons were recorded under increasing irrigation intervals (decreasing number of watering, 8 watering throughout growing season and the mean values are 12.04 and 12.5% in the first and second growing seasons respectively. On the other hand, the lowest mean values were recorded under giving 1_2 watering throughout growing season. Increasing the mean values of pre-harvest fruit drop percentage under increasing irrigation intervals might be due to under the conditions small fruits were formed and sometimes were infected consequently the chance of dropping for these fruits will be high. Comparing with the traditional irrigation which practices by level growing in the studied area. These findings are in agreement with these obtained by El-Abd (2005) and Treeby *et al* (2007) on Washington navel orange.

3. Yield:

3.1. Fruit number/tree

Presented data in Table (6) showed that, the mean values of fruit number/tree were affected by irrigation treatments where the highest mean values were recorded under control treatment (giving 16 irrigations through the whole growing season) comparing with the other irrigation treatments (giving 1_2 and 8 irrigations through the whole growing season) and the values are 380.75, 365.50 and 356.25, in the first season and 374.00, 364.25 and 343.25 in the second season respectively. Increasing number of fruits/tree under control treatments (traditional irrigation I_0) comparing with other irrigation treatments (I_1 and I_2) might be due to increasing amount of applied water which leads to increasing availability of nutrients consequently increasing amount of nutrients uptake by plants, so, forming strong and health trees with a good vegetative cover (canopy), therefore increasing number of branches which are effective and carrying a high number of fruits comparing with other treatments which received a little amount of irrigation water. Consequently increasing number of fruits per tree. These findings are in a great harmony with these show by El-Abd (2005) and Treeby *et al* (2007) on Washington navel orange.

3-2: Fruit weight (g):

Tabulated data in Table (6) illustrated that the mean values of fruit weight were affected by irrigation treatments in the two growing seasons. The highest mean values were recorded under giving 1_2 irrigations through the whole growing season and the mean values are 235.37 and 228.97 (g) in the first and second growing seasons respectively. On the other hand, the lowest mean values in the two growing seasons were recorded under irrigation treatments (giving 8 watering throughout growing season). The mean values for fruit weight can be descended in order giving 12 > 16 **>** 8. These results are in a great harmony with these obtained by El-Abd (2005) on Washington navel orange.

3.3. Yield as kg/tree:

Data in Table (6) clearly illustrated that, the mean values of yield kg/tree were affected by irrigation treatments in the two growing seasons. The highest mean values in the two growing seasons were recorded under irrigation treatment I_1 (giving 1_2 irrigations through the whole growing season) comparing with the other irrigation treatments I_0 and I_2.

Table (6): The mean values of yield kg/tree as affected by irrigation treatments in the two growing seasons.

Irrigation treatments	Fruit set (%)	Pre-harvest fruit drop (%)	Fruit number/tree	Fruit weight (g)	Yield (kg/tree)
	Season 1				
I_0	5.97 C	9.01 B	380.75 A	214.27 B	81.58 AB
I_1	8.26 A	7.50 C	365.50 A	235.37 A	86.03 A
I_2	6.63 B	12.04 A	356.25 A	204.31 B	72.81 B
mean	6.95	9.52	367.50	217.98	80.14
	Season 2				
I_0	5.95 A	8.60 B	374.00 A	211.40 AB	79.07 A
I_1	6.62 A	7.35 C	364.25 AB	228.97 A	83.28 A
I_2	6.37 A	12.54 A	343.25 B	205.55 B	70.53 B
mean	6.31	9.49	360.50	215.31	77.63

Means followed by a common letter in column under each data are not significantly at the 5% level by DMRT.

The mean values of yield kg/tree can be descended in order I_1> I_0> I_2 in the two growing seasons and the mean values are 86.03, 83.28 and 81.58 kg/tree and 79.07, 72.81and 70.53 kg/tree under I_1, I_0 and I_2 in the first and second growing seasons respectively. Increasing the mean values of yield kg/tree under I_1 comparing with I_0 (traditional irrigation) might be due to under traditional irrigation the number of fruits/tree increasing so, the competition among fruits to take their nutritional requirements is high, therefore the values of fruits are small, consequently, the weight of these fruits are low, so, decreasing the mean values of yield kg/tree under traditional irrigation (I_0) comparing with other irrigation treatments (I_1&I_2). These findings are in a great harmony with these obtained by El-Sabrout and Kassem (2002) and El-Abd (2005) on Washington navel orange, and García-Tejero, I., *et al* (2010) on a commercial citrus orchard Citrus sinensis (L.) Osbeck, cv. Salustiano.

4. Fruit quality parameters:

Concerning the effect of irrigation water regime on peel punctures resistance(g/cm³), soluble solids content (SSC%), vitamin C (mg/100 ml juice), acidity (%), reducing, non-reducing and total sugars (%), presented data in Table (7) clearly illustrated that the mean values of the above mentioned studied parameters were affected by irrigation treatments in the two growing seasons. The highest mean values for these parameters were recorded under I_2 (giving 8 irrigation through the whole growing season) comparing with the other irrigation treatments I_0 and I_1. The mean values of the above mentioned parameters can be descended in order I_2 > I_1 > I_0 in the two growing seasons.

Increasing the above mentioned parameters under irrigation treatment I_2 (giving 8 irrigations through the whole growing season) or so-called exposed to stress might be due to increasing number of irrigations that's means that increasing amount of irrigation water applied there for, increasing amount of applied water raising water table level and hence increasing amount of uptake (of soil solution) consequently irrigation water percentage in the fruits this leads to make dilution for fruit juice. So, decreasing the mean values of the above mentioned parameters under traditional irrigation like local farmers practices which received the highest number of irrigation comparing with the other irrigation treatments. These results are in a great harmony with those obtained by El-Abd (2005) on Washington navel orange. and García-Tejero, I., *et al* (2010). on a commercial citrus orchard Citrus sinensis (L.) Osbeck, cv. Salustiano.

Table (7): The effect of irrigation water regime on fruit quality parameters.

Irrigation treatments	Peel resistance (gm/cm³)	SSC (%)	V C mg/100 ml juice	Acidity (%)	Sugars (%)		
					reducing	Non-reducing	total
	Season 1						
I_0	48.25 C	10.17 B	49.55 B	0.95 A	4.61 C	4.34 A	8.95 C
I_1	64.57 B	11.14 A	53.20 A	0.97 A	5.28 B	4.24 A	9.52 B
I_2	70.16 A	11.63 A	55.58 A	0.98 A	5.51 A	4.27 A	9.78 A
means	60.99	10.98	52.78	0.97	5.13	4.28	9.42
	Season 2						
I_0	50..72 C	10.85 B	51.70 B	0.93 A	4.13 B	4.43 A	8.56 B
I_1	68.77 B	11.95 A	57.92 A	0.96 A	4.43 B	4.58 A	9.01 A
I_2	71.37 C	12.10	56.19AB	0.97 A	5.44 A	4.87 A	10.31 A
means	63.62	11.63	55.27	0.95	4.67	4.63	9.29

Means followed by a common letter in column under each data are not significantly at the 5% level by DMRT.

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تأثير النظام المائى على المحصول وجودة الثمار للبرتقال أبوسره وبعض العلاقات المائية فى منطقة شمال وسط الدلتا

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*** قسم بحوث الموالح - محطة بحوث البساتين بسخا – مركز البحوث الزراعية– مصر**

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*****قسم الفاكهة المتساقطة- محطة بحوث البساتين بسخا – مركز البحوث الزراعية- الجيزة – مصر**

أجريت هذه الدراسة خلال موسمى ٢٠١٠/٢٠٠٩ و٢٠١٠ /٢٠١١على أشجار برتقال أبوسره عمر ٢٠ عام نامية فى أراضى طينية منزرعة على مسافات ٥ × ٥م مطعومة على اصل نارنج بمنطقة مطوبس بمحافظة كفرالشيخ –مصر .بهدف دراسة تأثير معاملات الرى على محصول البرتقال ابوسره وصفات جودة الثمار وكذلك بعض العلاقات المائيه .

قسمت الأشجار إلى ثلاث مجموعات كل مجموعة خضعت الى واحدة من المعاملات الأتيه :

(I_0) رى الفلاح التقليدى (معاملة المقارنة) ١٦ رية في الموسم، (I_1) ١٢ رية في الموسم و(I_2) ٨ ريات خلال الموسم وهى المعاملة التى تمثل ظروف نقص المياه.

ومن النتائج المتحصل عليها فى كلا موسمى الدراسة يتضح أن أعلى القيم بالنسبة للماء المضاف والاستهلاك المائى سجلت تحت معاملة الرى I_0 مقارنة بالمعاملات I_1 وI_2 ٧٦٠٠،٧٤٠٠ و٤٩٤٠،٤٤٤٠ م٣ /فدان للماء المضاف و الاستهلاك المائى فى الموسم الأول والثانى على الترتيب . وعلى العكس من ذلك فإن أقل القيم سجلت تحت معاملة الرى (I_2) فى موسمى الدراسة. بصفة عامة فان قيم الماء المضاف والاستهلاك المائى فى كلا موسمى الدراسة تم ترتيبها تنازلياً $I_2 < I_1 < I_0$.

وأنإنتاجية الماء (PW) وإنتاجية مياه الرى (PIW) تأثرت بمعاملات الرى المدروسة فى الموسمين حيث أن النتائج المتحصل عليها أن قيم (PW) >(PIW) أعلى القيم لكلا عنصرى الدراسة سجلت تحت معملة الرى I_2 مقارنة ب I_0 , I_1 بصفة عامة القيم بالنسبة لعنصرى الدراسة يكون ترتيبها تنازليا $I_2 < I_1 < I_0$ فى موسمى الدراسة .

وبالنسبة للمحصول تأثر بصورة واضحة بمعاملات الرى فى كلا موسمى الدراسة وأعلى القيم سجلت عند معاملة الرى (I_1) وكانت أقل القيم تحت معاملة الرى (I_2) فى كلا موسمى الدراسة.

بصفة عامة متوسط القيم بالنسبة لمحصول البرتقال أبوسرة ونسبة عقد الثمارومتوسط وزن الثمرة يمكن ترتيبها تنازلياً $I_1 > I_0 > I_2$. وبالنسبة لعدد الثمار للشجرة الواحدة كانت أعلى القيم تحت معاملة (I_0) وأقلها تحت معاملة (I_2) وذلك خلال موسمى الدراسة وعن تساقط ما قبل الجمع كان ترتيبها كما يلى $I_2 > I_0 > I_1$ فى كلا الموسمين وكانت صفات جودة الثمار(السكريات وفيتامين ج والمواد الصلبة الذائبة) فى هذا الاتجاة $I_2 < I_1 < I_0$ فى كلا الموسمين.

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