ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 46(1): Ho. 123-138, (2008).

REGULATED DEFICIT IRRIGATION AND SOIL MANAGEMENT PRACTICES IN 'PICUAL' OLIVE TREES FOR YIELD AND OIL PRODUCTION

BY

El-Deeb, M. D.*; El-Sebsy, A.A.; Ahmed, S. A.*** and El-Alakmy, H.A.**

* Plant Production Dept. (Fruit Science), Fac. Environ. Agric. Sci., Suez Canal Univ.

** Soil and Water Dept., Fac. Environ. Agric. Sci., Suez Canal Univ.

*** Plant Production Dept. (plant protection), Fac. Environ. Agric. Sci., Suez Canal Univ.

ABSTRACT

The experiment was conducted during 2005 and 2006 seasons at the Olive Research Farm, Faculty of Environmental Agricultural Sciences at El-Arish, Suez Canal University to study the effect of regulated deficit irrigation and soil management practices in 'Picual' olive trees on fruit and oil yields, fruit and oil quality. Three irrigation treatments 100%, RDI-70% and RDI-35% of evapotranspiration (ETc) were applied from March to November. In addition, four soil management practices hand hoeing was applied at three times to the depth of about 15 cm in mid April, mid June and mid August and three mulching treatments i.e. black plastic, olive pomace and rice straw mulches were spread on ground around trees in mid February. The irrigated trees at 100% of ETc (control) and the RDI-70% of ETc and mulched trees with black polyethylene plastic and rice straw mulches succeeded in increasing fruit and oil yields, and recorded the lowest values of alternate bearing index. Fruit quality increased significantly by increasing the amount of water. The oil acidity, peroxide, iodine values, oil chlorophyll and carotenoids content were decreased by increasing water stress. The olive trees subjected to this RDI-treatment (70% of ETc) with black plastic mulch or rice straw mulch saved water without reducing fruit yield or oil production as well as increased water use efficiency.

INTRODUCTION

The olive (*Olea europea* L.) is a subtropical evergreen tree, in the family Oleaceae. World production of olive fruit is about 17.31 million ton per annum. Approximately 92% of this production is used for the extraction of olive oil and the remaining 8% is consumed as table olive. In Egypt, olive production increased considerably during the last two decades due to the horizontal extension in new reclaimed soil, olive area reached about 125369 feddan with total fruit production of 544640 tons according to the statistics offered by the Ministry of Agriculture and Land Reclamation, Egypt, 2006. The olive trees has been regarded as part of the social and cultural traditions of every country and region in which it has been grown. Because of its long life and hardiness and its adaptation to a climate of little rainfall and long summer in which precipitation is practically nil or little benefit. At the same time it is subject to intense evaporation. Water usually being the limiting factor in olive production. When maximum olive yield is desired large amount of water for irrigation are needed, but these amounts are not always in the Mediterranean area. Regulated deficit irrigation strategies in olive trees are important to save water or increasing water use efficiency without reducing yield (Alegre *et al.*, 2000).

Mulching also may mitigate some of the harmful effects of saline irrigation water (5000 ppm) by decreasing moisture stress (Spiers, 1983) or by reducing infiltration (Hassan, 1985 and Oster *et al.*, 1986).

The objective of this study was to evaluate the effect of regulated deficit irrigation (RDI) and mulching treatments on 'Picual' olive trees. The beneficial effects of mulches such as conservation of soil moisture, less soil consumption, weeds control, reduced fertilizer leaching and increased soil temperatures have been documented (Schales and Sheldrake 1965 and Waggoner *et al.*, 1960).

MATERIALS AND METHODS

The experiment was conducted during 2005 and 2006 seasons at the Olive Research Farm, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University. Seventy two Picual olive trees (*Olea europea* L.) about 16 -year- old planted in a loamy sand soil and spaced at 6 x 7 m under drip irrigation system were used. Soil samples were taken in late October 2004 at three depths (0-30), (30-60) and (60-90cm) from the soil surface for mechanical and chemical analyses, (Table, 1) according to Piper (1947), while initial soil moisture constant were determined, (Table, 1) according to Richard's (1954). Irrigation water was pumped from a depth of 70 m in El-Arish area were subjected for chemical analysis (Table, 2) according to Agriculture Hand Book (1954).

Table (1): Mechanical, chemical analyses and soil moisture constants of the tested olive orchard soil.

Parameter		Soil depth (cm) (0 – 30)	(30 – 60)	(60 – 90)
Mechanical analysis				
Sand (%)		88.39	81.73	74.65
Silt (%)		4.51	8.93	12.70
Clay (%)		7.10	9.34	12.65
Soil texture		Loamy sand	Loamy sand	Sandy Loam
Bulk density ($g.cm^{-3}$)		1.55	1.51	1.42
Chemical analysis				
Cations (meq.l-1)	Ca++	6.72	7.95	12.37
	Mg++	5.10	5.87	8.03
	Na+	8.67	11.28	13.37
	K+	0.40	0.36	0.35
Anions (meq.l-1)	CO3--	-	-	-
	HCO3-	2.45	2.36	2.69
	Cl-	10.41	12.63	13.22
	SO4--	8.03	10.47	18.21
E.C ($dS.m^{-1}$)		2.09	2.55	3.43
pH		7.9	8.3	8.7
Organic matter (%)		0.18	0.13	0.09
Water holding capacity				
Saturation Percent (S.P)		24	25	44
Field Capacity (F.C)		5.92	6.22	15.81
Wilting Point (W.P)		2.51	2.93	7.02
Available Water (A.W)		3.41	3.29	8.79

According to Piper, (1947) and Richard's (1954).

Three irrigation treatments were applied: a control considered as fully irrigated treatment during whole seasons (100 % of crop evapotranspiration "ETc"). Additionally to control treatment, two regulated deficit irrigation (RDI) treatments RDI-70% and RDI-35% of ETc were imposed which were irrigated for the whole seasons, by applying only 70 % and 35 % of crop evapotranspiration (Table 3).

Table (2): Chemical analysis of artesian well water used for irrigation.

Parameters		Value
E.C	($dS.m^{-1}$)	7.03
Conc.	(ppm)	4499
pH		7.3
Soluble cations ($meq.l^{-1}$)		
	Ca^{++}	16.56
	Mg^{++}	17.60
	Na^{+}	35.87
	K^{+}	0.27
Soluble anions ($meq.l^{-1}$)		
	$CO3^{=}$	-
	$HCO3^{-}$	6.13
	Cl^{-}	42.26
	$SO4^{=}$	21.91
Water quality(1)		
	Total salinity	C4
	Sodicity	S1

(1) water quality was according to Agriculture Hand Book (1954).

Table (3): Irrigation scheduling program for Picual olive trees grown at El-Arish, North Sinai Governorate in 2005 and 2006 seasons.

Month	Amount of irrigation water(1) ($m^3.fed^{-1}$)					
	100% of ETc (Control)		RDI-70%of ETc		RDI-35%of ETc	
	2005	2006	2005	2006	2005	2006
March(2)	140	99.97	98	69.98	49	34.99
April	429	427.15	300.3	299	150.15	149.5
May	465	465	325.5	325.5	162.75	162.75
June	500	510	350	357	175	178.5
July	527	527	368.9	368.9	184.45	184.45
August	520	527	364	368.9	182	184.45
September	420	420	294	294	147	147
October	341	322.73	238.7	225.91	119.35	112.96
November(2)	153	144.76	107.1	101.33	53.55	50.67
Total amount of irrigation (m3 .fed -1. year-1)	3495.00	3443.61	2446.50	2410.52	1223.25	1205.27

Where:
(1) Scheduling amount of irrigation water was according to Doorenbos and Pruitt, (1977).
(2) 11 days during March and 10 days during November.

Irrigation treatments were applied from March 20th and continued until November 15th of both seasons and were programmed weekly during the afternoon based on calculation crop evapotranspiration (ETc) using pan evaporation and modified blaney-criddle methods.

Four soil management practices were applied, hand hoeing and three mulching treatments. Weeds were removed from ground around olive trees by hand hoeing to the depth of about 15 cm in mid April, mid June and mid August, in both seasons, respectively. In mid February 2005, black polyethylene sheets

(50 μ thick × 120 cm wide), olive pomace (about 15 cm thick layer) and rice straw (about 15 cm thick layer) were spread on ground around trees as a mulch.

The effect of different regulated deficit irrigation (RDI) and soil management (SM) practices on Picual olive trees were evaluated through the following measurements:

a) Fruit yield, oil yield, yield efficiency and biennial bearing index

Harvesting was carried out at the normal time and ripening stage as soon as the 75 % of olive fruits reached the violet skin color. The yield efficiency was calculated by dividing yield Kg fruit. Tree^{-1} by both the TCSA an average of trunk cross-sectional area according to the following equation of Westwood and Roberts (1970) as follows:

Yield efficiency = $Y/TCSA$ **(Kg. cm^{-2})**

Where:

Y = Fruit yield (Kg)

TCSA = Trunk cross-sectional area (cm^2).

b) Fruit and oil quality

Adequate number of fruits were taken at random and transferred to the laboratory to determine fruit quality i.e. fruit weight, fruit volume, fruit length, diameter, flesh weight, stone weight and flesh: stone ratio as well as fruit moisture and oil content.

The oil quality i.e., acid value (free fatty acids) (%), peroxide value (meq.O_2.Kg oil^{-1}) saponification value (mg .g^{-1}) and were determined according to the methods of A.O.A.C. (1990). The relative percentage of fatty acids in the olive oil was determined according to Fryer *et al.*, (1960) and Nelson *et al.*, (1969) by the following equation:

$$\text{Fatty acid} = \frac{\text{Area under each peak}}{\text{Total area under all peaks}} \times 100\,(\%)$$

The results were exposed to proper statistical analysis of variance for a randomized complete block design (two factors split plots) using MSTATC computer program (Russell, 1986) with three replicates and each replicate was represented by two trees. Duncan's multiple range test was used for comparison between means. Different alphabetical letters in the column are significantly differed at (0.05) level of significance (Duncan, 1955). The same trees were used throughout both experimental seasons.

RESULTS AND DISCUSSION

1. Fruit yield, yield efficiency and oil yield

Data in table (4-a) show that the fruit and oil yields as well as yield efficiency were increased linearly by increasing the amount of water. The irrigated trees at 100% of ETc and RDI-70% ETc were the similar in this respect. On the contrary, the irrigated trees at RDI-35% of ETc had the least values in both seasons. These results go in line with those reported by Deidda *et al.*, (1990), Goldhamer *et al.*, (1994) and Alegre, *et al.*, (2000) they found that fruit yield was decreased with the lowest irrigation rate. Generally, This higher yield was due to higher root distribution, vegetative growth, reproductive development and to the increasing fruit weight and fruit volume as a result of the right amount of irrigation.

Concerning the specific effect of soil management practices (SM), data in table (4-a) reveal that the black polyethylene sheet mulch and rice straw mulch caused the highest significant effect on fruit yield, yield efficiency and oil yield, followed by olive pomace mulch in both seasons. While, hand hoeing treatment (control) resulted in a remarkable decrease in this respect. In short, mulches were effective in increasing fruit yield, yield efficiency and oil yield than non-mulched trees (hand hoeing-control). These results are in agreement with those reported by Khokhar *et al.*, (2001), Briccoli *et al.*, (2002) and Hernández *et al.*, (2005) they found that the productivity was improved under the grass mulch treatment.

Regarding the response of fruit and oil yields and yield efficiency to the interaction effect between regulated deficit irrigation (RDI) and soil management (SM) practices, data in table (4-b) reveal that the 100% of ETc with black polyethylene or rice straw mulches caused the height significant increase in fruit and oil yields and yield efficiency, followed by RDI-70% of ETc with black polyethylene plastic or rice straw mulches. While, RDI-35% of ETc with hand hoeing treatment had the least values in this concern. On the other hand, other interactions induced intermediate values between the previously mentioned categories.

2. Alternate bearing index

Table (4-a) shows that the irrigated trees at RDI-70% of ETc succeeded in decreasing alternate bearing index and gave the least value (10.56), followed by 100% of ETc (11.91). While, the irrigated trees RDI-35% of ETc failed to decrease the alternate bearing index and recorded the highest value (13.49). These results are in agreement with those obtained by Alegre, *et al.*, (2000).

Concerning the specific effect of soil management (SM) practices on alternate bearing index, data in table (4-a) show generally that black polyethylene mulched trees gave the least values of alternate bearing index (9.26), followed by rice straw mulched trees (10.62) and olive pomace mulch (13.20) respectively. On the contrary, the hand hoeing treatment recorded the highest alternate bearing index (14.53). These results agree coincide with those reported by Khokhar *et al.*, (2001), Briccoli *et al.*, (2002) and Hernández *et al.*, (2005) in olive trees. In the other words, the mulching significantly decreased alternate bearing index than non-mulched trees.

Regarding the interaction effect between regulated deficit irrigation (RDI) and soil management (SM) treatments. Data presented in table (4-b) show that the least value of alternate bearing index was noticed with RDI-70% of ETc by black polyethylene mulch or by rice straw mulch treatments (8.99 and 8.74), respectively. While, RDI-35% of ETc by hand hoeing treatment had a highest value in this respect (23.00). Other treatments occupied intermediate position. In other words, the interaction between deficit water and mulching treatments caused a significant reduction in alternate bearing index. Our results are in conformity with the findings of Pankaj *et al.*, (2000).

Finally, the higher fruit and oil yields as well as yield efficiency with right amount of water applied under black polyethylene sheet and rice straw mulch may be due to increasing number of inflorescences, flowers, soil moisture content from ground around trees and soil nutrient availability. (Mukherjee *et al.*, 2004).

3. Fruit and oil quality response

Some fruit and oil quality of 'Picual' olive trees as affected by regulated deficit irrigation (RDI) and soil management (SM) treatments during 2005 and 2006 seasons are presented in tables (5-a -5-b).

3.1. Fruit length, width, shape index, volume and weight.

Table (5-a) reveals that in both studied seasons, fruit length, fruit width, fruit shape index, fruit volume and fruit weight increased linearly with regulated deficit irrigation. The 100 % of ETc – irrigated trees and RDI-70% of ETc – irrigated trees were similar in this concern and gave the highest values of fruit length, fruit width and fruit shape index. On the other hand, the RDI- 35% of ETc had the most depressive effect in both seasons. These results are in agreement with those reported by Proietti and Antognozzi (1996) in olives cultivar 'Ascolana' and Serrano (1998) who found that that fruit weight and fruit volume were significantly higher for 0.60 ETp treatment compared with the control with out irrigation in "Azeiteira" table olive trees.

Concerning the specific effect of soil management (SM) practices, data in the same table show that the highest fruit length, width, volume and weight were given by black polyethylene mulch and rice straw mulch, followed by olive pomace mulch, regardless of shape index. In the meantime, hand hoeing (control) had the least values in this concern in both seasons. Similar results agree with Tedeschini *et al.*, (2003) who found that in mulching treatments the shape and symmetry of olive fruits were better and more uniform in straw mulch and the weight was 33% higher relative to the untreated control olive trees.

Table (4-a): Specific effect of regulated deficit irrigation and soil management treatments on fruit yield, yield efficiency, oil yield and biennial bearing index of 'Picual' olive trees during 2005 and 2006 seasons.

Treatment	Fruit yield (Kg. tree^{-1})		Yield efficiency(1) (Kg.cm^{-2})		Oil yield (Kg. tree^{-1})		Biennial bearing index(2)
	2005	2006	2005	2006	2005	2006	
1. Specific effect of regulated deficit irrigation (RDI) treatments							
100%ETc (Control)	44.58 a	56.64 a	0.051 a	0.060 a	8.96 a	11.64 a	11.91 b
RDI-70% ETc	43.28 a	53.50 a	0.050 a	0.059 a	7.69 ab	10.54 a	10.56 c
RDI-35% ETc	20.39 b	26.75 b	0.027 b	0.033 b	4.15 b	5.01 b	13.49 a
2. Specific effect of soil management (SM) practices							
Hand hoeing (Control)	28.24 c	37.84 c	0.034 c	0.045 b	5.12 d	6.77 c	14.53 a
Black plastic mulch	40.91 a	49.26 a	0.047 a	0.053 a	8.83 a	10.95 a	9.26 d
Olive pomace mulch	35.55 b	46.36 b	0.043 b	0.051 a	6.16 c	8.03 b	13.20 b
Rice straw mulch	39.63 ab	49.05 a	0.046 a	0.053 a	7.60 ab	10.50 a	10.62 c

Table (4-b): The interaction effect between regulated deficit irrigation and soil management treatments on fruit yield, yield efficiency, oil yield and biennial bearing index of 'Picual' olive trees during 2005 and 2006 seasons.

Treatment		Fruit yield (Kg. tree-1)		Yield efficiency(1) (Kg.cm-2)		Oil yield (Kg. tree-1)		Biennial bearing index(2)
		2005	2006	2005	2006	2005	2006	
100% ETc	Hand hoeing	35.47 d	45.73 cd	0.042 bc	0.052 bc	6.49 cd	8.70 bcde	12.64 cd
	Black plastic mulch	50.42 a	61.30 a	0.056 a	0.064 a	11.62 a	13.98 a	9.74 e
	Olive pomace mulch	43.16 bc	57.39 abc	0.051 ab	0.059 ab	7.63 bc	10.44 bc	14.15 b
	Rice straw mulch	49.27 a	62.14 a	0.055 a	0.063 a	10.04 ab	13.45 a	11.55 cde
RDI-70% ETc	Hand hoeing	34.15 e	43.67 cde	0.041 bc	0.051 bc	6.02 cde	7.91 cde	12.23 cd
	Black plastic mulch	49.53 a	59.31 ab	0.055 a	0.062 a	10.35 a	12.84 ab	8.99 f
	Olive pomace mulch	41.03 c	53.33 bcd	0.049 abc	0.060 ab	7.10 bcd	8.92 bcd	13.04 c
	Rice straw mulch	48.40 ab	57.67 abc	0.056 a	0.062 a	7.29 bcd	12.47 abc	8.74 f
RDI-35% ETc	Hand hoeing	15.10 g	24.12 g	0.020 e	0.031 e	2.85 f	3.70 g	23.00 a
	Black plastic mulch	22.77 f	27.17 fg	0.029 cd	0.034 d	4.52 def	6.03 de	8.81 f
	Olive pomace mulch	22.47 f	28.37 ef	0.030 cd	0.035 d	3.75 ef	4.74 f	11.61 cde
	Rice straw mulch	21.23 f	27.34 fg	0.027 d	0.034 d	5.47 de	5.58 e	12.58 cd

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Regarding, the interaction effect between regulated deficit irrigation (RDI) and soil management treatments, data in table (5-b) show that irrigation treatments by mulches were significantly interactive for fruit length, width, shape index, volume and weight. The irrigated trees at 100% ETc with black polyethylene mulch or with rice straw mulch gave the highest values in this respect in the both seasons. While, RDI-35% of ETc with hand hoeing treatment had the least values in this concern. The other interactions revealed inbetween effect.

Table (5-a): Specific effect of regulated deficit irrigation and soil management treatments on fruit shape parameters of Picual olive trees during 2005 and 2006 seasons.

Treatment	Fruit length (cm)		Fruit width (cm)		Shape index (L/ W)		Fruit volume (ml)		Fruit weight (g)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
1.Specific effect of regulated deficit irrigation (RDI) treatments –										
100%ETc (Control)	3.74 a	3.67 a	2.38 a	2.71 a	1.56 a	1.35 a	7.16 a	6.02 a	2.38 a	6.68 a
RDI-70% ETc	3.22 a	3.39 a	2.17 b	2.59ab	1.44ab	1.31 a	6.10ab	5.78 a	2.17 b	6.66 a
RDI-35% ETc	2.47 b	3.05 b	1.84 c	2.53b	1.34 b	1.20 b	4.83b	4.36 b	1.84 c	5.58 b
2.Specific effect of soil management (SM) practices										
Hand hoeing (Control)	2.71 b	2.20 b	1.88 c	1.52 b	1.43 b	1.44 c	5.19 b	4.43 c	4.84 c	5.29 c
Black plastic mulch	3.39 a	2.66 a	2.33 a	1.70 a	1.42 b	1.56 a	6.57 a	6.27 a	6.99 a	7.27 a
Olive pomace mulch	3.25 a	2.18 b	2.14 b	1.52 b	1.48 a	1.43 d	6.10ab	4.89bc	6.25 b	5.67bc
Rice straw mulch	3.22 a	2.56 a	2.18ab	1.69 a	1.45 a	1.54 b	6.27 a	5.94ab	6.38ab	6.98 a

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

3.2. Fruit flesh thickness, flesh and stone weights, and flesh: stone ratio.

The data in table (6-a) show that the trees irrigated at 100% of ETc and RDI-70% of ETc – irrigated trees had the highest values of fruit flesh thickness, flesh and stone weights, and flesh: stone ratio. On the contrary, irrigated trees at RDI-35% of ETc produced the least significant effect in this respect. These results tend to agree with those reported by Serrano (1998) in "Azeiteira" table olive trees and d'Andria *et al.*, (2004) who found that pulp-stone ratio peaked at an irrigation depth of 66% of ETc.

As for the specific effect of soil management (SM) practices. Data represented in the same table, reveal that mulches caused a high significant increase in fruit flesh thickness, flesh weight, stone weight and flesh: stone ratio. The black polyethylene plastic and rice straw mulches showed to be the most effective in this result, followed by olive pomace mulch in the both seasons. On the other hand, hand hoeing treatment (control) induced less stimulative effect in this respect.

Regarding the interaction between regulated deficit irrigation (RDI) and soil management (SM) treatments, data presented in table (6-b) reveal that fruit flesh thickness, flesh weight, stone weight and flesh: stone ratio were increased due to water amount x mulch treatment. Furthermore, the irrigated trees at 100% of ETc or RDI-70% of ETc with black polyethylene or rice straw mulches induced more simulative effect on fruit flesh thickness, flesh weight, stone weight and flesh: stone ratio. While, RDI-35% of ETc by non-mulched trees (hand hoeing) had the least values in this respect. The other interactions came inbetween.

Table (5-b): The interaction effect between regulated deficit irrigation and soil management treatments on fruit shape parameters of Picual olive trees during 2005 and 2006 seasons.

Treatment		Fruit length (cm)		Fruit width (cm)		Shape index (L/W)		Fruit volume (ml)		Fruit weight (g)	
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
100% ETc	Hand hoeing	3.34b	2.33 d	2.20 cd	1.54defg	1.52 ab	1.50 c	5.90 de	4.97def	2.20 cd	5.64 d
	Black plastic mulch	3.90a	3.08 a	2.57 a	1.90 a	1.53 ab	1.63 b	7.97 a	7.17 a	2.57 a	7.87 a
RDI-70% ETc	Olive pomace mulch	3.86a	2.26 de	2.37 b	1.64 cd	1.63 a	1.38 d	7.60 ab	5.63 cd	2.37 b	5.67 d
	Rice straw mulch	3.86a	3.01 a	2.38 b	1.76 b	1.55 ab	1.74 a	7.17abc	6.30 bc	2.38 b	7.52 ab
	Hand hoeing	2.48c	2.17 ef	1.82 e	1.56 def	1.36 cd	1.39 d	5.00 ef	5.00 de	1.82 e	5.62 d
	Black plastic mulch	3.67ab	2.67 b	2.38 b	1.61 de	1.48 bc	1.66 ab	6.67bcd	6.60 ab	2.38 b	7.50 ab
RDI-35% ETc	Olive pomace mulch	3.34b	2.17 ef	2.19 cd	1.43 g	1.44 c	1.50 c	6.10cde	4.80 ef	2.19 cd	6.39 c
	Rice straw mulch	3.39b	2.54 c	2.30bc	1.74 bc	1.49bc	1.46 cd	6.63bcd	6.70 ab	2.30 bc	7.12 b
	Hand hoeing	2.31c	2.10 f	1.63 f	1.46 fg	1.41 c	1.44 cd	4.67 f	3.33 g	1.63 f	4.61 e
	Black plastic mulch	2.59c	2.24 de	2.05 d	1.60 de	1.25 e	1.40 d	5.07 ef	5.03 de	2.05 d	6.44 c
	Olive pomace mulch	2.55c	2.10 f	1.85 e	1.49 efg	1.38 cd	1.41 d	4.60 f	4.23 f	1.85 e	4.94 e
	Rice straw mulch	2.42c	2.15 ef	1.85 e	1.57 def	1.31cde	1.42 cd	5.00 ef	4.83 ef	1.85 e	6.31 c

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

3.3. Moisture and oil content of fruit.

Data presented in table (7-a) reveal that fruit moisture was increased by increasing the amount of water, while fruit oil content took an opposite trend in this concern. Both treatments 100% of ETc and RDI-70% of ETc induced statically similar effect on fruit moisture content, while both treatments RDI-70% of ETc and RDI-35% of ETc gave significantly similar effect on fruit oil content in both seasons.

Table (6-a): Specific effect of regulated deficit irrigation and soil management treatments on flesh and stone parameters of 'Picual' olive trees during 2005 and 2006 seasons.

Treatment	Flesh thickness (cm)		Flesh weight (g)		Stone weight (g)		Flesh : Stone Ratio	
	2005	2006	2005	2006	2005	2006	2005	2006
1. Specific effect of regulated deficit irrigation (RDI) treatments								
100%ETc (Control)	1.19 a	0.42 a	6.06 a	5.50 a	1.03 a	1.18 a	5.91 a	4.68 b
RDI-70% ETc	0.88 b	0.39 ab	5.40 ab	5.51 a	0.94 ab	0.97 b	5.72 a	5.71 a
RDI-35% ETc	0.57 c	0.37 b	3.98 b	4.81 b	0.89 b	0.95 b	4.49 b	5.09 ab
2. Specific effect of soil management (SM) practices								
Hand hoeing (Control)	0.75 c	0.37 b	3.96 b	4.94 b	0.88 b	0.96 b	4.47 b	5.22 a
Black plastic mulch	1.02 a	0.44 a	5.95 a	6.21 a	1.04 a	1.05 a	5.76 a	5.98 a
Olive pomace mulch	0.91 ab	0.36 b	5.31 a	4.11 c	0.94 a	1.05 a	5.65 a	3.85 b
Rice straw mulch	0.85 bc	0.40 ab	5.38 a	5.83 a	0.95 a	1.05 a	5.61 a	5.47 a

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Table (6-b): The interaction effect between regulated deficit irrigation and soil management treatments on flesh and stone parameters of 'Picual' olive trees during 2005 and 2006 seasons.

Treatment		Flesh thickness (cm)		Flesh weight (g)		Stone weight (g)		Flesh : Stone Ratio	
		2005	2006	2005	2006	2005	2006	2005	2006
100% ETc	Hand hoeing	1.10 b	0.38 c	4.92 e	4.59 d	0.96cde	1.08 bc	5.13 b	4.27cde
	Black plastic mulch	1.31 a	0.47 a	6.84 a	6.67 a	1.13 a	1.20 ab	6.19 a	5.56abc
	Olive pomace mulch	1.17 ab	0.37 c	6.33 bc	4.70 d	1.00bcd	1.25 a	6.31 a	3.49 e
	Rice straw mulch	1.19 ab	0.44 ab	6.17 bc	6.05 b	1.03 b	1.17 ab	6.00 a	4.86bcde
RDI-70% ETc	Hand hoeing	0.70 de	0.37 c	3.57 g	5.48 c	0.86 fg	0.91 d	4.17 c	6.03 ab
	Black plastic mulch	1.06 b	0.45 ab	6.65 ab	6.53 ab	1.02 bc	0.94 d	6.55 a	6.97 a
	Olive pomace mulch	0.92 c	0.35 c	5.55 d	3.93 e	0.94 de	1.01 cd	5.88 ab	3.89 de
	Rice straw mulch	0.83 cd	0.39 bc	5.84 cd	6.11 b	0.93 e	1.01 cd	6.30 a	6.08 ab
RDI-35% ETc	Hand hoeing	0.44 g	0.36 c	3.37 g	4.76 d	0.82 g	0.89 d	4.13 c	5.37bcd
	Black plastic mulch	0.68 ef	0.39 bc	4.36 f	5.42 c	0.96cde	1.02 cd	4.53 bc	5.41 bc
	Olive pomace mulch	0.64 ef	0.36 c	4.07 f	3.72 e	0.86 fg	0.89 d	4.75 bc	4.18cde
	Rice straw mulch	0.54 fg	0.38 c	4.13 f	5.33 c	0.91 ef	0.98 cd	4.54 bc	5.47 bc

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Generally, according to these data, it can be conclude that Fruit quality and the physical and chemical characteristics were positively correlated with the 100 % of ETc and RDI-70 % of Etc, respectively except for oil content, it took an opposite trend in this respect. These results go in line with those reported by Ismail and Stavroulakis (1999) they found that olive fruit from the irrigated plot had increased moisture content.

Concerning, the specific effect of soil management (SM) practices. Data in table (7-a) indicate that mulches significantly increased moisture and oil content of fruit than unmulched-trees (hand hoeing-control). The highest values of moisture and oil content of fruit were recorded by the black polyethylene mulched trees and rice straw mulched trees, followed by olive pomace mulched trees in the both seasons. Similar results agree with Tedeschini *et al.*, (2003) who found that the percentage olive oil content of fruits and the dry matter showed relatively minor differences between treatments.

Regarding, the interaction between regulated deficit irrigation (RDI) and soil management (SM) treatments. Data in table (7-b) show that the irrigation treatments by mulches were significantly effective for moisture and oil content of fruit. the highest moisture content of fruit was given by 100% of ETc by black polyethylene mulch or by rice straw mulch and RDI-70% of ETc by black polyethylene mulches, respectively. While, RDI-35% of ETc with hand hoeing treatment had the least fruit moisture content in the both seasons. The other interactions came inbetween. On the other hand, the highest fruit oil content was given by RDI-35% of ETc x black polyethylene or rice straw mulches and RDI-70% of ETc x black polyethylene mulch or rice straw mulch. While, the interaction between 100% of ETc x hand hoeing treatment had the lowest values in this respect. The other interactions had inbetween effect.

1.4. Acidity, peroxide value and refractive index

Table (7-a) reveals that in both studied of oil seasons, acidity and peroxide values were increased linearly with increasing the amount of irrigation water. The irrigated trees at 100 % ETc gave the highest acidity and peroxide values, on the other hand, irrigated trees at RDI-35% of ETc had the most depressive effect in this respect. The refractive index was not shown any significant response to all tested treatments in both seasons. This pattern is similar to that reported by Ismail and Stavroulakis (1999) who reported that the extracted olive oil from the irrigated trees had higher acidity, peroxide value and oxidative stability compared with the extracted oil from the non irrigated plot.

Concerning, the specific effect of soil management (SM) practices. Data in table (7-a) show that mulches caused a highest significant reduction in acidity and peroxide values. The least acidity and peroxide values were obtained with black polyethylene mulched-trees, followed by rice straw mulched-trees. While, the highest values of acidity and peroxide values were noticed with unmulched-trees (hand hoeing-control) in both season. In addition, there were no significant differences between soil management practices in the refractive index in both seasons. Similar results were reported by Tedeschini *et al.*, (2003) who found the chemical parameters of olive oil content had a significant influence to weed control relative to the untreated control.

Regarding, the interaction effect between regulated deficit irrigation (RDI) and the soil management (SM) treatments, the results in table (7-b) indicate that acidity and peroxide values were decreased due to regulated deficit irrigation x mulching treatments. Furthermore, the irrigated trees at RDI-35% of ETc by black polyethylene mulch proved to be the superior interaction in reducing acidity and peroxide values. While, irrigated trees at 100% of ETc by unmulching (hand hoeing) gave the highest acidity and peroxide values. The other tested interactions came inbetween with significant differences among them. Concerning the refractive index, data in the same table reveal that there were no significant differences among all interactions in both seasons.

Table (7-a): Specific effect of regulated deficit irrigation and soil management treatments on fruit and oil chemical parameters of Picual olive trees during 2005 and 2006 seasons.

Treatment	Fruit moisture content (%)		Fruit oil content (on fresh weight basis) (%)		Acid value (%)		Peroxide value (meq.O_2.Kg oil-1)		Refractive index (25°C)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
1.Specific effect of regulated deficit irrigation (RDI) treatments										
100%ETc (Control)	65.65 a	67.49 a	19.60 b	17.93 b	0.99 a	0.96 a	1.634 a	1.69a	1.467a	1.466 a
RDI-70% ETc	63.47ab	65.99ab	20.26ab	18.81ab	0.80 b	0.79b	1.590ab	1.63ab	1.466 a	1.466 a
RDI-35% ETc	55.47 b	60.96 b	20.74 a	19.41 a	0.64 c	0.68 c	1.516 b	1.555 b	1.466 a	1.468 a
2.Specific effect of soil management (SM) practices										
Hand hoeing (Control)	56.47 b	61.53 c	18.60 c	16.75 c	0.89 a	0.88 a	1.615 a	1.715 a	1.467 a	1.466 a
Black plastic mulch	65.28 a	67.61 a	21.66 a	20.76 a	0.75 b	0.71 c	1.541 c	1.519 c	1.466 a	1.467 a
Olive pomace mulch	61.08ab	64.38b	19.58bc	17.68bc	0.81 ab	0.84 ab	1.594ab	1.657ab	1.466 a	1.467 a
Rice straw mulch	63.31 a	65.73ab	20.97ab	19.68ab	0.76 b	0.80 b	1.568 b	1.622 b	1.466 a	1.466 a

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Table (7-b): The interaction effect between regulated deficit irrigation and soil management treatments on fruit and oil chemical parameters of Picual olive trees during 2005 and 2006 seasons.

Treatment		Fruit moisture content (%)		Fruit oil content (on fresh weight basis) (%)		Acid value (%)		Peroxide value (meq.O_2 .Kg oil^{-1})		Refractive index (25°C)	
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
100% ETc	Hand hoeing	62.43 bc	62.10 cde	18.30 f	16.42 d	1.04 a	1.13 a	1.672 a	1.791 a	1.467 a	1.468 a
	Black plastic mulch	68.13 a	69.97 a	20.33 bcdef	19.99 abc	0.97 ab	0.81 bc	1.611 abc	1.575 d	1.467 a	1.465 a
	Olive pomace mulch	64.90 abc	68.03 ab	19.17 def	16.73 cd	0.98 ab	0.98 ab	1.635 ab	1.713 ab	1.466 a	1.467 a
	Rice straw mulch	67.13 a	69.87 a	20.60 abcde	18.58 bcd	0.95 abc	0.91 abc	1.609 abcd	1.697 b	1.466 a	1.465 a
RDI-70% ETc	Hand hoeing	59.70 cde	64.63 cd	18.60 ef	16.85 cd	0.92 abcd	0.84 bc	1.622 abc	1.724 ab	1.466 a	1.464 a
	Black plastic mulch	66.83 ab	68.33 ab	22.17 ab	20.45 ab	0.72 cd	0.70 cd	1.530 de	1.551 de	1.465 a	1.467 a
	Olive pomace mulch	62.50 bc	65.27 abc	19.27 cdef	18.04 bcd	0.88 bcd	0.79 bcd	1.612 abc	1.648 bc	1.465 a	1.467 a
	Rice straw mulch	64.87 abc	65.73 abc	21.00 abcd	19.92 abc	0.70 d	0.81 bc	1.597 bcd	1.623 bcd	1.467 a	1.465 a
RDI-35% ETc	Hand hoeing	47.27 f	57.87 e	18.90 ef	16.99 cd	0.70 d	0.68 de	1.552 bcde	1.629 bcd	1.467 a	1.467 a
	Black plastic mulch	60.87 bcd	64.53 bcd	22.47 a	21.84 a	0.57 f	0.63 e	1.482 e	1.431 e	1.465 a	1.468 a
	Olive pomace mulch	55.83 e	59.83 de	20.30 bcdef	18.28 bcd	0.66 ef	0.70 cd	1.534 de	1.611 cd	1.468 a	1.468 a
	Rice straw mulch	57.93 de	61.60 cde	21.30 abc	20.53 ab	0.63 ef	0.70 cd	1.497 e	1.547 de	1.464 a	1.467 a

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

3.5. Oil pigments content

Results presented in table (8-a) declare that oil pigments content (chlorophyll A, B and carotenoids) were increased significantly by increasing available water. The 100% of ETc treatment recorded a highest values of oil pigments content, followed by RDI-70% of ETc treatment. Meanwhile, the least values of oil pigments content were obtained by irrigated trees at RDI-35% of ETc in both seasons. These results go in line with those reported by Motilva *et al.*, (2000). On olive trees cv. Arbequina.

Concerning the specific effect of soil management (SM) practices on the concentration of oil pigments , data presented in table (8-a) show that mulches succeeded in increasing oil pigments content (chlorophyll A, B and carotenoids). Both mulches, rice straw and black polyethylene caused high significant increases in oil pigments content, followed by olive pomace mulch. While, non-mulched trees (hand hoeing-control) gave the least values in this respect.

Regarding, the interaction effect between regulated deficit irrigation (RDI) and soil management (SM) treatments. Data in table (8-b) show that the irrigation treatments by mulching were significantly interactive for oil pigments content. The most obvious increment in oil pigment content was observed with irrigated trees at 100% of ETc by rice straw mulch. On the other hand, irrigated trees at RDI-35% of ETc by hand hoeing induced less stimulative effect in oil pigments content (chlorophyll A, B and carotenoids) in the both seasons. The other interactions came inbetween.

3.6. Fatty acids composition

As for, the response of fatty acids composition to regulated deficit irrigation (RDI) treatments, data in table (9-a) reveal that the irrigation treatments influenced the fatty acids composition (saturated and unsaturated fatty acids). The irrigated trees at 100% of ETc gave the highest values of saturated fatty acids Palmitic and Stearic acids (17.28 and 16.75%) and (3.35 and 3.07 %) and unsaturated fatty acids Palmitoleic, Oleic, Linoleic and Linolenic acids (1.31 and 1.23 %), (71.75 and 72.39 %), (11.60 and 12.59 %) and (0.89 and 0.88 %) respectively. Meanwhile, the RDI-35% of ETc treatment gave the least values in Palmitic and Stearic acids (14.13 and 13.52 %) and (2.77 and 2.86%) and Palmitoleic, Oleic, Linoleic and Linolenic acids (1.08 and 1.09 %), (64.93 and 66.01 %), (8.81 and 8.76 %) and (0.78 and 0.78 %) respectively, in both seasons. These results tend to agree with those reported by Stefanoudaki *et al.*, (2001) in olive trees, cv. Koroneiki and Jamie, (2006) who reported that free fatty acids tended to increase as the season progressed in olive oil cultivars Mission, Paragon and Corregiolla.

Concerning, the specific effect of soil management (SM), from the same table reveal that all mulching-treatments caused the highest significant increase in fatty acids composition (saturated and unsaturated fatty acids). The olive pomace mulched-trees gave the highest values of saturated fatty acids Palmitic and Stearic acids (17.00 and 16.10%) and (3.24 and 3.11%) respectively, in both seasons as compared with unmulched-trees (hand hoeing-control) (14.52 and 14.14%) and (2.89 and 3.05%) respectively. Concerning the unsaturated fatty acids, the rice straw mulched-trees gave the highest values of Palmitoleic, Linoleic and Linolenic acids (1.33 and 1.35 %), (11.10 and 11.66%) and (0.84 and 0.87 %) respectively in both seasons, while the olive pomace mulched-trees recorded the highest values of Oleic acid (69.07 and 68.71 %) respectively. On the contrary, the unmulched-trees (hand hoeing-control) produced the least significant effect in this respect. Similar results agree with Tedeschini *et al.*, (2003).

Table (8-a): Specific effect of regulated deficit irrigation and soil management treatments on some oil pigments content of 'Picual' olive trees during 2005 and 2006 seasons.

Treatment	Oil chlorophyll A content (mg. l-1)		Oil chlorophyll B content (mg. l-1)		Oil carotenoids content (mg. l-1)	
	2005	2006	2005	2006	2005	2006
1.Specific effect of regulated deficit irrigation (RDI) treatments						
100%ETc (Control)	5.66 a	6.08 a	5.47 a	6.18 a	0.899 a	1.199 a
RDI-70% ETc	4.66 ab	4.97 b	5.19 ab	5.26 ab	0.718 ab	0.912 ab
RDI-35% ETc	4.09 b	4.15 c	4.01 b	3.53 b	0.446 b	0.658 b
2.Specific effect of soil management (SM) practices						
Hand hoeing (Control)	4.19 c	4.76 b	3.11 d	4.21 c	0.554 c	0.715 c
Black plastic mulch	5.17 ab	5.25 ab	5.64 b	4.97 b	0.753 ab	1.048 a
Olive pomace mulch	4.45 b	4.88 b	4.18 c	5.29 ab	0.640 b	0.870 b
Rice straw mulch	5.40 a	5.37 a	6.61 a	5.49 a	0.803 a	1.059 a

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Table (8-b): The interaction effect between regulated deficit irrigation and soil management treatments on some oil pigments content of 'Picual' olive trees during 2005 and 2006 seasons.

Treatment		Oil chlorophyll A content (mg. l-1)		Oil chlorophyll B content (mg. l-1)		Oil carotenoids content (mg. l-1)	
		2005	2006	2005	2006	2005	2006
100% ETc	Hand hoeing	4.89 bcd	5.62 b	3.60 fg	5.10 cde	0.713 cd	0.869 bcd
	Black plastic mulch	5.92 ab	6.11 ab	6.70 abc	6.44 ab	0.957 ab	1.396 a
	Olive pomace mulch	5.55 abc	6.10 ab	4.52 cdef	6.25 abc	0.823 bc	1.046 abc
	Rice straw mulch	6.26 a	6.49 a	7.04 a	6.94 a	1.101 a	1.485 a
RDI-70% ETc	Hand hoeing	4.00 de	4.86 cd	3.23 gh	4.92 de	0.633 d	0.738 cd
	Black plastic mulch	4.97 bc	5.30 bc	6.21 bc	4.48 ef	0.866 b	1.144 ab
	Olive pomace mulch	4.03 de	4.57 bcde	4.43 def	5.46 cd	0.630 d	0.866 bcd
	Rice straw mulch	5.64 abc	5.16 bcd	6.87 ab	6.19 bc	0.743 bcd	0.900 bc
RDI-35% ETc	Hand hoeing	3.69 f	3.79 f	2.51 h	2.62 h	0.317 f	0.538 e
	Black plastic mulch	4.62 cd	4.35 de	4.02 efg	3.98 fg	0.435 e	0.604 de
	Olive pomace mulch	3.76 ef	3.98 ef	3.59 fg	4.16 f	0.468 e	0.699 d
	Rice straw mulch	4.29 cde	4.46 cde	5.91 bcd	3.35 g	0.564 de	0.791 cd

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test.

Regarding, the interaction effect between regulated deficit irrigation (RDI) and soil management (SM). Results in table (9-b) indicate that the most obvious increments in saturated fatty acids composition was observed with interaction between 100% of ETc by olive pomace mulch (19.72 and 20.60%) and (3.94 and 3.37%) respectively, in both seasons. While, the interaction between RDI-35% of ETc with black polyethylene plastic mulch gave the least values of saturated fatty acids (13.62 and 13.18%) and (2.65 and 2.56%) respectively. Concerning, the unsaturated fatty acids, data in the same table show that the interaction between 100% of ETc x rice straw mulch gave the highest values of Palmitoleic, Linoleic and Linolenic acids (1.42 and 1.65 %), (12.67 and 13.83 %) and (0.91 and 0.90 %) respectively, while the interaction between 100% of ETc x olive pomace mulch recorded the highest values of Oleic acid (73.26 and 73.47 %) respectively. On the contrary, the interaction between RDI-35% of ETc x unmulched-trees (hand hoeing) produced the least significant effect in this result. The other interactions came in between. On the other hand, the interaction between.

Finally, the same regulated deficit irrigation (RDI) applied (100%, 80%, 60% and 40%) in previous years (El-Alakmy, 2004) on the same trees have affected significantly fruit yield, physical and chemical characterized of fruit, oil yield and oil content. Thus, it can be inferred, that irrigation at 100% and RDI-70% of ETc can meet adequately crop water requirements, in the area of experiment, for optimal plant growth and yield.

Table (9-a): Specific effect of regulated deficit irrigation (RDI) and soil management treatments on fatty acids contents of Picual olive trees during 2005 and 2006 seasons.

Treatment	Saturated fatty acids (%)				Unsaturated fatty acids (%)							
	Palmitic (C16:0)		Stearic (C18:0)		Palmitoleic (C16:1)		Oleic (C18:1)		Linoleic (C18:2)		Linolenic (C18:3)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
1.Specific effect of regulated deficit irrigation (RDI) treatments												
100%ETC (Control)	17.28 a	16.75 a	3.35 a	3.07 a	1.31 a	1.23 a	71.75 a	72.39 a	11.60 a	12.59 a	0.89 a	0.88 a
RDI-70% ETC	15.22 b	14.53 b	3.03 ab	3.06 a	1.22 ab	1.19 a	69.90ab	69.24ab	10.37ab	10.45 b	0.80 ab	0.83 a
RDI-35% ETC	14.13 c	13.52 c	2.77 b	2.86 b	1.08 b	1.09 b	64.93 b	66.01 b	8.81 b	8.76 c	0.78 b	0.78 b
2.Specific effect of soil management (SM) practices												
Hand hoeing (Control)	14.52 c	14.14 c	2.89 b	3.05 ab	1.01 b	1.04 c	66.44 b	67.03 c	8.82 b	8.55 b	0.72 b	0.74 b
Black plastic mulch	15.18 b	15.27 b	2.99 b	2.81 b	1.20 ab	1.13 b	69.08ab	69.99ab	10.44ab	11.04ab	0.82 ab	0.85 a
Olive pomace mulch	17.00 a	16.10 a	3.24 a	3.11 a	1.27 a	1.15 b	70.84 a	71.11 a	10.67ab	11.15ab	0.90 a	0.85 a
Rice straw mulch	15.47 b	14.21 c	3.08 ab	3.00 ab	1.33 a	1.35 a	69.07ab	68.71 b	11.10 a	11.66 a	0.84 a	0.87 a

Table (9-b): Interaction effect between regulated deficit irrigation (RDI) and soil management treatments on fatty acids contents of Picual olive trees during 2005 and 2006 seasons

Treatment		Saturated fatty acids %				Unsaturated fatty acids %							
		Palmitic (C16:0)		Stearic (C18:0)		Palmitoleic (C16:1)		Oleic (C18:1)		Linoleic (C18:2)		Linolenic (C18:3)	
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
RDI-70% ETC	Hand hoeing	15.11 de	14.46 de	3.05 bcd	3.10 ab	1.21 bc	1.15 cd	69.81 cd	71.56 bc	9.55 cd	9.90 e	0.77 abc	0.78 bc
	Black plastic mulch	16.94 bc	17.21 b	3.22 b	2.80 cd	1.33 ab	1.03 de	71.37 bc	72.81 ab	12.11 ab	13.56 ab	0.93 a	0.90 a
	Olive pomace mulch	19.72 a	20.60 a	3.94 a	3.37 a	1.28 b	1.10 cde	73.26 a	73.47 a	12.05 ab	13.08 abc	0.95 a	0.92 a
	Rice straw mulch	17.34 b	14.74 d	3.18 bc	3.00 abc	1.42 a	1.65 a	72.55 ab	71.71 bc	12.67 a	13.83 a	0.91 a	0.90 a
RDI-35% ETC	Hand hoeing	14.39 defg	14.06 ef	2.88 d	3.04 abc	0.99 d	1.12 cde	67.41 d	66.60 d	8.79 d	7.95 gh	0.71 bc	0.79 bc
	Black plastic mulch	14.97def	15.42 c	3.09 bcd	3.08 abc	1.22 bc	1.18 cd	70.53 bcd	70.16 c	10.53 bc	10.74 d	0.79 abc	0.83 ab
	Olive pomace mulch	16.18 c	14.37de	3.04 bcd	2.98 bc	1.27 b	1.17 cd	72.16 b	70.48 c	10.23 bc	11.16 c	0.85 ab	0.83 ab
	Rice straw mulch	15.33 d	14.25 def	3.10 bc	3.13 ab	1.39 a	1.30 b	69.48 cd	69.70 cd	11.92 abc	11.96 bc	0.83 ab	0.86 ab
100% ETC	Hand hoeing	14.07 efg	13.91 ef	2.74 de	3.00 abc	0.84 e	0.86 e	62.11 f	62.93 f	8.12 f	7.80 h	0.69 c	0.66 c
	Black plastic mulch	13.62 g	13.18 g	2.65 e	2.56 d	1.06 cd	1.19 c	65.34 e	66.99 d	8.67 d	8.81 f	0.74 bc	0.81 abc
	Olive pomace mulch	15.11de	13.34 fg	2.73 de	2.99 abc	1.26 b	1.19 c	67.09 d	69.39 cd	9.74 bcd	9.22 ef	0.89 ab	0.81 abc
	Rice straw mulch	13.73 fg	13.65 efg	2.96 cd	2.88 c	1.17 bcd	1.10 cde	65.19 e	64.72 e	8.71 d	9.20 ef	0.79 abc	0.85 ab

Means followed by the same letter(s) within each column are not significantly different at the 0.05 level, according to Duncan's multiple range test

REFERENCES

A.O.A.C. (1990): Official Methods of Analysis. 15th ed., Association of Official Agriculture Chemists Washington D.C., USA.

Agriculture Hand Book (1954): Diagnosis and improvement of saline and alkali soils. United States Department of Agriculture. Washington, D.C. 20402.

Alegre, S; Marsal, J.; Tovar, M. J.; Mata, M.; Arbonés, A. and Girona, J. (2000): Regulated deficit irrigation in olive trees (*Olea europea* L.) CV. 'Arbequina' for oil production. Proceedings of 4th International Symposium on Olive Growing. Valenzano (Bari) Italy.25-30 September 2000.

Bricooli, B.C; Toscano, P.; Antonuccio, S. and Failla, O. (2002): Effect of grass cover on vegetative, productivity and nutritional status of olive. Informatore Agrario. 2002; 58(31): 43-46.

d'Andria R.; Lavini, A.; Morelli, G.; Patumi, M.; Terenziani, S.; Calandrelli ,D. and Fragnito, F. (2004): Effects of water regimes on five pickling and double aptitude olive cultivars (*Olea europea* L.). The Journal of Horticultural Science and Biotechnology. January 2004 , 79(1): 18-25.

Deidda, P.; Dettori, S.; Filigheddu, M.R.; Virdis, F. and Pala, M. (1990): Lysimetric analysis of water requirements for young table-olive trees., Acta-Horticulturae., No. 286: 259-261.

Doorenbos, J; and Pruitt, W.O. (1977): Crop water requirements. FAO, Irrigation and drainage, paper No.24. Rome.

Duncan, B. D. (1955): Multiple Range and Multiple F-tests. Biometrics, 11: 1- 42.

El-Alakmy, H. A. (2004): Regulated deficit irrigation in 'Picual' olive trees for oil production. M.Sc. Thesis. Faculty of Environmental Agricultural Sciences at El-Arish, Suez Canal university, Ismailia, Egypt.

Fryer, F.H; Ormand, W.L. and Crump, G.M. (1960): Triglyceride elution by gas chromatography. J. Am. Oil Chem. Soc., 37: 589-590.

Goldhamer, D.A.; Dunai, J. and Ferguson, L. (1994): Irrigation requirements of olive trees and responses to sustained deficit irrigation. Acta- Horticulturae, 356: 172-175.

Hassan F.A. (1985): Drip irrigation and crop production in arid regions. Proc. 3rd intl. Drip Trickle Irri. Congr. ASAE, St. Joseph Mich, p. 150-155.

Hernández A.J; Lacasta, C.; and Pastor, J. (2005): Effects of different management practices on soil conservation and soil water in a rainfed olive orchard. Agricultural Water Management. 77 (1-3), 22 August 2005: 232-248.

Ismail, A.S. and Stavroulakis, G. (1999): Effect of irrigation on the quality characteristics of organic olive oil. Proceedings 3rd Int. ISHS Symp. On olive growing.(September 1999). Acta Horticulture, No.474: 687-690.

Khokhar U.U; Gautam, J.R; and Sharma, M.K. (2001): Effect of various floor management systems on growth. Yield and leaf nutrient status of olive cv. Leccino. Horticultural Journal. 2001, 14: 1, 43-48; 12 ref.

Motilva, M.J.; Tovar, M. J.; Romero, M. P.; Alegre, S. and Girona, J. (2000): Influence of regulated deficit irrigation strategies applied to olive trees (Arbequina cultivar) on oil yield and oil composition during the fruit ripening period. Journal of the Science of Food and Agriculture, 80: 2037-2043.

Mukherjee S.; Paliwal, R. and Pareek, S. (2004): Effect of water regime, mulch and kaolin on growth and yield of ber (Ziziphus mauritiana Lamk). Journal of Horticultural Science & Biotechnology. 79 (6): 991-994.

Nelson, J.P; Milum, A.J. and Fister, H.D. (1969): Gas chromatographic determination of tocopherols and sterol in soya sludges and residues; an improved method. J. Am. Oil Chem. Soc., 47: 259-261.

Oster, J.D; Hoffman, G.J. and Robinson, F.E. (1986): Dealing with salinity, management alternatives, crop, water, and soil. Clif. Agr. 38: 29-32.

Pankaj, B; Barua, H.K; Borah, A; and Barua, P. (2000) Plant growth and yield of Assam lemon as influenced by different drip irrigation levels and plastic mulch. Annalsof Biology Ludhiana. 2000, 16: 1, 17-20; 5 ref.

Piper, C.S. (1947): Soil and plant analysis. The University of Adelaide (Australia) pp: 59-74.

Proietti, P. and Antognozzi, E. (1996): Effect of irrigation on fruit quality of table olives (*Olea europea*),cultivar 'Ascolana tenera'. New Zealand Journal of Crop and Horticultural Science, 1996;24: 175-181.

Richard's, L.A. (1954): Diagnosis and improvement of saline and alkaline soils. U.S.D.A. Handbook No. 60.

Russell, D.F. (1986): MSTATC Director, Crop and Soil Sciences Department, Michigan State University, Computer Program Package Version 2.10.

Schales, F.D. and Sheldrake, R. (1965): Mulch effects on soil conditions and musk-melon response. Proc. Amer. Soc.Hort. Sci. 88:425-480.

Spiers, S.M. (1983): Irrigation and peatmoss for the establishment of rabbit eye blue-berries. Hort. Science 18: 936-937.

Stefanoudaki, E.; Chartzoulakis, K.; Koutsaftakis, A. and Kotsifaki, F. (2001): Effect of drought stress on qualitative characteristics of olive oil of cv. Koroneiki. National Agricultural Research Foundation. Grasas Aceites Sevilla. No. 52:3-4,202-206.

Tedeschini J; Stamo, B.; Huqi, B.; Pace, H.; Shahini, S.; Ismaili, H.; Panajoti , D. and Bacaj, M. (2003): Organic methods of vegetation management and olive insect control. Fruit Tree Research Institute (FTRI), University of California, 2003, 24 (1): 78-91.

Waggoner, P.E; Miller, P. M. and De Roo, H. C. (1960): Plastic mulching, principles and benefits. Conn. Agr. Expt. Sta., New Haven 634: 124-128.

Westwood, M. N. and Roberts, A. N. (1970): The relationship between trunk cross-sectional area and weight of apple trees. J. Amer. Soc. Hort. Sci. 1970, 95: 28-30.

تنظيم خفض مياه الري وخدمة التربة في أشجار الزيتون البيكوال على المحصول وإنتاجية الزيت

محمد دياب الديب*،عطية عبد الوهاب السيسي، سيد على أحمد***، هاني عبد الله العلاقمي**

* قسم الإنتاج النباتي (فاكهة)– كلية العلوم الزراعية البيئية بالعريش– جامعة قناة السويس

** قسم الأراضي والمياه– كلية العلوم الزراعية البيئية بالعريش– جامعة قناة السويس

*** قسم الإنتاج النباتي (وقاية نبات)– كلية العلوم الزراعية البيئية بالعريش– جامعة قناة السويس

أجريت التجربة بالمزرعة البحثية بكلية العلوم الزراعية البيئية بالعريش ، جامعة قناة السويس ، محافظة شمال سيناء ، وذلك خلال عامي ٢٠٠٥ ، ٢٠٠٦ على أشجار الزيتون البيكوال عمر ١٦سنة والمنزرعة في تربة رملية طميية على أبعاد ٦ × ٧ م ، وقد رويت الأشجار بمياه بئر ملوحته ٤٥٠٠ جزء في المليون بهدف دراسة تأثير خفض مياه الري وخدمة التربة على المحصول و صفات جودة الثمار والزيت لأشجار الزيتون البيكوال. ورويت الأشجار تحت ثلاث مستويات الري بنسبة ١٠٠% و ٧٠% و ٣٥% من البخر– نتح المحصولي . وكما كانت معاملات خدمة التربة المطبقة كما يلي: العزيق اليدوي (بدوت تغطية للتربة) : ثلاث مرات خلال أشهر أبريل – يونيه – أغسطس ، والتغطية بالبلاستيك الأسود (٥٠ميكرون سمك ١٢٠X عرض) ، و التغطية بتفل الزيتون (١٥ سم سمك الطبقة) ، و التغطية بقش الأرز (١٥ سم سمك الطبقة) تم ري المعاملات السابقة ابتداء من شهر مارس وحتى شهر نوفمبر. كما تم تغطية الأشجار ابتداءاً من شهر فبراير ٢٠٠٥ وحتي شهر نوفمبر ٢٠٠٦.تم تجربه المعاملات من خلال نظام تصميم القطاعات كاملة العشوائية (المنشقة الواحدة ذات العاملين) في ثلاث مكررات و كل مكررة ممثلة بشجرتين وتم تحليل النتائج إحصائياً. أبرزت النتائج أن معاملة الري عند مستوى ١٠٠% من البخر – نتح المحصولي (المقارنة) ومستوى ٧٠ % من البخر – نتح المحصولي قد أعطت أعلى محصول من الثمار والزيت وكذلك أعلي كفاءة للمحصول ، وكذلك أعلى القيم في الخصائص الفيزيائية والكيميائية للثمار والزيت وذلك بالمقارنة بالري عند مستوى ٣٥ % من البخر – نتح المحصولي. كما أوضحت النتائج أن التغطية بكل من البلاستيك الأسود و قش الأرز أحدثت تأثير واضحاً على كل من محصول الثمار والزيت وكفاءة المحصول وكذلك خصائص جودة الثمار والزيت ومحتواها من الصبغات ومن الأحماض الدهنية الحرة ، يليها التغطية بتفل الزيتون وذلك بالمقارنة بمعاملة العزيق اليدوي (المقارنة). وبخصوص تأثير التفاعل ، أبرزت النتائج أن التفاعل بين الري ١٠٠% أو ٧٠% من البخر – نتح المحصولي مع التغطية بالبلاستيك الأسود أو بقش الأرز قد أعطت زيادة ملحوظة في محصول الثمار والزيت وكفاءة المحصول. وجودة الثمار والزيت مقارنة التفاعل بين الري عند مستوى خفض–٣٥ % من البخر – نتح المحصولي مع العزيق اليدوي أقل القيم في محصول الثمار وكفاءة المحصول ومحصول الزيت.