Misr J. Ag. Eng., 26(1): 149- 169 IRRIGATION AND DRAINAGE

COMPARISON OF MICRO IRRIGATION SYSTEMS FOR OLIVE TREES

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ABSTRACT

Micro-Irrigation Systems (MIS) apply water through small devices which deliver it onto the soil surface very near to the plant, which means in this context the use of bubbler, mini–sprinkler and trickle irrigation systems.

From 2003 to 2006, 13 feddans of field research were established in sandy soil at Wadi EL Natrown On-Farm Irrigation Department Research Station operated by the Water Management and Irrigation System Research Institute, to evaluate the effect of MIS on olive trees. The experimental site was arranged in a split plots design. On 08-02-2003 olive trees (Olea europaea L, Calamata cv.) were planted in the center of an irrigated round base of 1 m diameter. The distance between the tree rows and the trees within the same row are 5ms. Each plot was divided into six replicates giving 18 experimental plots.

All the micro irrigation systems were designed with the same control head components which consists of non- return valve, flow meter, venturi, air valve, pressure relief valve and 3 pressure gauges. Regarding the distributor units technical specifications and their placement: 1) For the trickle treatment 4 emitters (12 l/h) per each tree placed on one lateral line PE 16 mm diameter passing through the center of the tree round base; where each emitter is 30 cm distant from the next one; 2) For the bubbler treatment one bubbler per each tree (100 l/h) placed in the tree round base , 25 cm distance from the tree stem moving monthly in 180° clockwise to maintain good water distribution; 3) For the mini- sprinkler treatment one mini-sprinkler (70 l/h) per each tree with the same procedure as the bubbler.

A comparison was made between the different systems taking into account the following points: olive trees morphology (plant height, stem diameter,

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shoots number/tree, leaves number/tree, shadow area and root distribution), number of fruits/tree, fruit weight, yield/tree, total yield per feddan, yield efficiency and both soil moisture content and soil salt distribution. Hydraulics characteristics for each type of MIS were also monitored.

The results obtained show the usefulness of trickle irrigation system in olive trees growing where the trees height increased (cm) by 10 and 9.2%, stem diameter (mm) increased by 6 and 14%, shoots number per tree increased by 8 and 14%, leaves number per tree increased by 13 and 17%, shadow area (cm^2) increased by 6 and 13% compared with bubbler and micro irrigation system respectively.

Trickle irrigation systems demonstrate the highest values of sand soil moisture content which is about (18.19, 16.66 and 10.45% by weight) in the soil layers (00–30), (30-60) and (60-90) cm, respectively, whereas the bubbler irrigation systems were (16.66, 14.46 and 9.01% by weight) in the previous soil layers respectively, followed by mini-sprinkler irrigation systems treatment which were about (10.45, 9.01 and 6.58% by weight) in the same soil layers respectively. The olive trees root distribution under trickle irrigation showed more regularity than other types due to root distribution relative to the placement and the number of irrigation distributors.

The net effect of trickle-irrigation was to increase water saving for producing one kilogram of olive fruits with 18 and 35 % less than with bubbler and mini-sprinkler respectively. The number of fruits increased under trickle irrigation by 16 to 24% while the olive tree yield (kg/tree) increased by 18 to 32% compared with bubbler and mini sprinkler irrigation system respectively. Trickle-irrigation can be recommended as an efficient irrigation system for olive trees in the irrigation areas of Wadi El Natrown in the west of the delta region.

INTRODUCTION

Olive (*Olea europaea L.*) is one of the most characteristic tree crops of the Mediterranean basin, where 98% of the land cultivated with lies within this region, where Spain, Italy and Turkey are the main producers. In Spain, the world's foremost olive-growing nation, the area devoted to this crop has increased by 27% over the last 20 years, while production has increased by 230% (MAPA, 2004). This increase in productivity is mostly due to the micro irrigation of orchards. Olive is considered as one of the important fruit crops in Egypt. The total acre area grown with olive reached about 108322 feddans in 2000 out of which 73301 feddans are in fruit production, with a total production of about 281745 ton fruits. Around 30% of this area is grown in newly reclaimed lands. (El Khawaga, 2007).

Studies have shown that micro irrigation systems can increase olive production (Moriana et al., 2002) thereby increasing the total oil production per tree. However, studies differ regarding their overall performance to applied water. For example, Patumi et al. (2000) found that irrigation of olives increased yields substantially over those that were rain-fed.

The term "micro-irrigation system" (MIS) describes a family of irrigation systems that apply water through small devices which deliver water onto the soil surface very near to the plant or below the soil surface directly into the plant root zone.

Bucks and Davis (1986) listed a number of potential advantages for micro-irrigation. They include increased beneficial use of water, enhanced plant growth and yield, reduced salinity hazard, improved application of fertilizer and other chemicals, limited weed growth, decreased energy requirements, and improved cultural practices.

Many authors have proposed indicators to measure irrigation system performance as summarized by Rao (1993) and have given examples of their use at particular irrigation systems (Bos et al. 1994). Moreover, Assouline et al (2002) have given the reasons of reduction in water consumption with trickle systems of small portion of the soil volume to be due to decreased surface evaporation and reduction of water movement below the root zone. Sorensen et al (2001) and Clinton et al (2004) showed that the maximum yield requires a uniform moisture distribution and maintaining high and non fluctuated soil moisture within the root zone. Also, Ibrahim (1993), and Hassan (2002) reported that the methods of irrigation vary in this concern and lead to high or low irrigation efficiency. Irrigation methods and/or amount of applied water had a variable effect in salt distribution in the soil profile and mineral nutrients content [Ibrahim et al (1988 and 1993), Abd EL Samed (1995), Al Khateeb (1996), Goda (1998), Laz et al (1999), and Patumi et al (2000).

Charles (2005), found that there is salinity accumulation in the root zone of tree crops that have been irrigated with trickle or micro-spray irrigation systems located in arid and semi-arid regions.

The spatial distribution of the root system in the soil can determine the potential of a plant to exploit the soil's resources, which are unevenly distributed on earth's surface or subjected to localized depletion by the roots (Lynch, 1995). The production of a primary root system, i.e., the primary branching from the radical may have a major impact on growth and survival of a plant (Mac-Isaac et al., 1989). A primary root system increases the surface area available for the uptake of water and mineral elements. In addition, with its architecture, a primary root system provides physical support to the developing shoot.

In general, root development under trickle irrigation is constrained to the soil volume wetted by the emitters, near the soil surface with root length density decreasing with depth (Stevens and Douglas, 1994). However, recent studies have shown that root water uptake is not always in direct proportion.

The objectives of the present investigation were to study the effect of water methods i.e. trickles, bubbler and mini-sprinkler irrigation systems on growth, yield, yield efficiency and both moisture and salt distribution in the soil profile under olive trees.

MATERIALS AND METHODS

3.1. Experimental Design

This study was conducted on a 13-feddans (one feddan equal $4200m^2$) "field at Wadi El Natrown Experimental Station, On Farm Irrigation Department operated by Water Management and Irrigation Systems Research Institute". The Experimental Station is located at about 106 km North-West of Cairo in (N 30° 24¯ and E 30° 30¯). The field trial was 13 feddans divided into three treatments, the first 3 feddans are used to test the trickle irrigation system, the second 5 feddans are used to test mini-sprinkler irrigation systems and the third 5 feddans are used to test bubbler irrigation systems.

The experimental site was arranged in a split plots design. On 08-02-2003 olive trees (*Olea europaea, Calamata* cv.) one month age were planted in the center of an irrigated round base with 1 m diameter, 5 meters was the distance between the tree rows and 5 meters were the distance between the trees within the row. Each plot was divided into six replicates giving 18 experimental plots.

All the micro irrigation systems were designed with the same control head component, which consists of non- return valve, flow meter, venturi fertilizer, air valve, pressure relief valve, 3 pressure gauges. The distributor unit technical specifications and their placement are as follows:

1) Regarding the trickle treatment 4 emitters (12 l/h at pressure operating 1 bar) per each tree placed on one lateral line PE 16 mm diameter passing through the center of the tree round base, where each emitter is 30 cm away from the next one and 15 cm from the olive tree stem.
2) Regarding the bubbler treatment one bubbler per each tree (100 l/h at pressure operating 1 bar) placed in the tree round base , 50 cm away from the tree stem and moving monthly in 180° clockwise to maintain good water distribution;
3) Regarding the mini- sprinkler treatment one mini-sprinkler (70 l/h at pressure operating 1 bar) with 1.2 m as wetted diameter for each tree with the same procedure as the bubbler.

Irrigation water and some soil physical and chemical properties were analyzed and recorded in table (1) according to the standard methods APHA (1989) and Peterson and Calvin (1965).

Climate data were measured at a weather station adjacent to the field. The irrigation water was applied according to the tree requirements and shortage of the soil moisture content, in order to raise the moisture content of the soil to its field capacity. Soil moisture samples were determined gravimetrically and calculated on dry weight following Garcia (1978). The amount or the depth of irrigation water was calculated according to the equation given by Israelsen and Hansen (1962).

Each micro irrigation system applied the same amount of irrigation water which is shown in table (2) as based on the average of the three studied seasons. For measuring the amount of irrigation water applied, a flow meter was used with each micro irrigation system. The tested trees received the usual agricultural treatments as followed by the olive orchards management.

3-1 The Studied Parameters

3-1-1. Morphological Characters of Olive Trees

Selected samples of olive trees from each MIS were taken at the end of the growing season (October) to measure the trees height (cm), stem diameter (mm), shoots number per tree, leaves number per tree and shadow area (cm^2).

3-1-2 Root Distribution of Olive Trees

Under different treatments, the olive trees were visually examined to measure root proliferation in horizontal and vertical direction. A rooting pattern examination was carried out through trenches of one-meter length, one meter wide and approximately 75 cm deep. A side wall of the trenches was carefully excavated to keep the root distribution pattern without damage. A semi-quantitative estimation was carried out according to Bohm, 1979.

Table (1): Some soil and irrigation water characteristics.

Soil depth	Soil physical properties (%)						
	Sand	Silt	Clay	Soil Texture	F.C	W.P	A.W	Bd (gm/cm^3)
00-30	94.5	3.5	2.0	Sand	15.0	5.5	9.5	1.65
30-60	95.7	3.0	1.3	Sand	16.7	4.3	12.4	1.44
60-90	97.0	2.0	1.0	Sand	18.5	3.9	14.6	1.30

Soil chemical properties										
Soil depth	EC (dS/m)	CO_3^{--}	HCO_3^-	CL^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	SAR
00-30	1.25		0.93	1.98	9.61	6.33	2.24	3.44	0.51	1.66
30-60	1.36		1.33	2.11	10.16	6.75	2.29	3.91	0.65	1.84
60-90	2.15		1.80	2.58	17.12	12.71	3.67	4.40	0.72	1.54

Water chemical properties									
EC (dS/m)	CO_3^{--}	HCO_3^-	CL^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	SAR
1.1	0.00	4.48	2.00	4.52	2.98	1.87	5.65	0.50	3.63

FC = Field Capacity; WP = Wilting Point; A.W= Available Water; Bd = Bulk density

Table (2): Average amount of water applied (m^3/fed and m^3/tree) during one growing year.

Months	Amount of Water applied	
	(m^3/fed)	**(m^3/tree)**
January	38.64	0.23
February	73.92	0.44
March	115.92	0.69
April	156.24	0.93
May	204.96	1.22
June	238.56	1.42
July	260.40	1.55
August	267.12	1.59
September	119.28	0.71
October	92.40	0.55
November	70.56	0.42
December	60.48	0.36
Total amount of water applied	1698.48	10.11

3-1-3 Olive Yield

In the selected olive trees samples, the number of fruits/tree, fruit weight (gm), yield (kg/tree) were determined at proper maturity to calculate the total yield per feddan.

3-1-4 Yield Efficiency (Y.E)

It was calculated according to the equation described by Ibrahim et al (1988) as follows:

$$Y.E. = \frac{\text{Water applied } (m^3/\text{fed})}{\text{Yield (kg/fed)}} = m^3 \text{ water/kg}$$

3-1-5 Soil Moisture and Salt Distribution

Soil samples were taken around the tree, 25 cm as distance from the tree stem and 24 hours after irrigation at three successive soil depths (00 - 30), (30 - 60) and (60 - 90)cm for each studied micro irrigation system treatment to obtain the average percentage of soil moisture.

The salt distribution was determined as electrical conductivity which was measured in 1:1 water soil extract of the soil samples taken around the tree for three successive soil depths (00-30), (30-60) and (60-90)cm for each studied micro irrigation system treatment.

3-2 Statistical Analysis

The obtained data were subject to the standard analysis of variance procedure. Values of L.S.D. were obtained whenever the calculated "F" values were significant at 5% and 1% levels. (Snedecor and Cochran 1980).

RESULTS and DISCUSSOIN

4-1. Morphological Characteristics of Olive Trees

Morphological characteristics of olive trees are very sensitive parameters as, they directly affect the quality and quantity of olive yield. The type of MIS which has a direct higher affect on morphological characteristics will lead to directly high yield.

Results presented in table (3) and figure (1) show the main values of morphological characteristics such as trees height (cm), stem diameter (mm), shoots number per tree, leaves number per tree and shadow area (cm^2) as affected by irrigation application during the three seasons of study. It is obvious from the results that all morphological characteristics increased significantly when olive trees were subject to trickle irrigation system either in the first, the second or the third studied seasons and the reduction in all morphological characters were more pronounced with that irrigated with mini-sprinkler irrigation system compared with the other irrigation systems in the three studied seasons of growth. Moreover, the average of trees height (113.85, 160.63 and 181.30cm), stem diameter (5.59, 6.48 and 8.53mm), shoots number per tree (3.56, 3.99 and 4.75), leaves number per tree (399.98, 431.06 and 439.66) and shadow area (92.76, 125.88 157.93 cm^2) in 2004, 2005 and 2006 seasons respectively, were obtained when olive trees were irrigated by trickle irrigation systems.

The increase in all morphological characters by trickle irrigation systems might be attributed to the favorable effect of maintaining soil moisture at no stress for the growth of olive trees, minimizing the irrigation water losses, and maximizing the water application efficiency.

Table (3): The effect of different MIS on average olive trees height (cm) stem diameter (mm), shoots number/tree and shadow area (cm^2) during 2004, 2005 and 2006 seasons.

MIS	Growing seasons	Trees height (cm)	Stem diameter (mm)	Shoots number per tree	Leaves number per tree	Shadow area (cm^2)
Trickle	2003-2004	113.85	5.59	3.65	399.98	92.76
	2004-2005	160.63	6.48	3.99	431.06	125.88
	2005-2006	181.30	8.53	4.75	439.66	157.93
	Average	155.26	6.87	4.13	423.57	125.52
Bubbler	2003-2004	110.10	5.33	3.47	337.98	87.51
	2004-2005	140.35	6.09	3.68	365.19	123.88
	2005-2006	173.20	7.91	4.18	394.95	141.17
	Average	141.22	6.44	3.78	366.04	117.52
Mini-Sprinkler	2003-2004	112.30	4.93	3.12	321.33	80.03
	2004-2005	130.58	5.39	3.54	344.27	110.17
	2005-2006	161.74	7.47	4.00	387.18	136.65
	Average	128.54	5.93	3.55	350.93	108.95
"F" test		**	**	**	**	**
LSD of irrigation systems at 0.01		1.26	0.58	0.012	0.049	0.035
at 0.05		0.83	0.38	0.008	0.032	0.023
LSD of seasons at 0.01		0.48	0.03	0.003	0.034	0.002
at 0.05		0.35	0.02	0.002	0.025	0.001
LSD of interaction at 0.01		0.83	0.05	0.010	0.058	0.004
at 0.05		0.60	0.02	0.004	0.042	0.003

4.2 Root Distribution of Olive Trees

Studying the root pattern development and water uptake is especially important for the optimization of irrigation water use efficiency. Water should not be applied in areas where roots are absent, or at a rate higher than the roots can possibly take up.

Figures (2, 3 and 4) indicate that approximately 83% of the root distribution under MIS observed, approximately was located in the upper 30 cms of the soil profile. This finding is in agreement with other studies of root distribution (San-Antonio, 1982; Hendrick and Pregitzer, 1996).

It is also indicated that root development under MIS is constrained to the soil volume wetted by the water distributor, near the soil surface with root length density decreasing with depth (Goldberg et al., 1971; Stevens and Douglas, 1994; Michelakis et al., 1993).

So, it is clear that, the olive trees root distribution under trickle irrigation showed more regularity than other types due to root distribution relative to the placement and the number of irrigation distributors; many irrigation distributor points increased the wetted area more than one point for the same quantity of water. This root distribution regularity under trickle irrigation will have a positive effect on olive trees morphology and yield compared with bubbler and mini sprinkler irrigation systems.

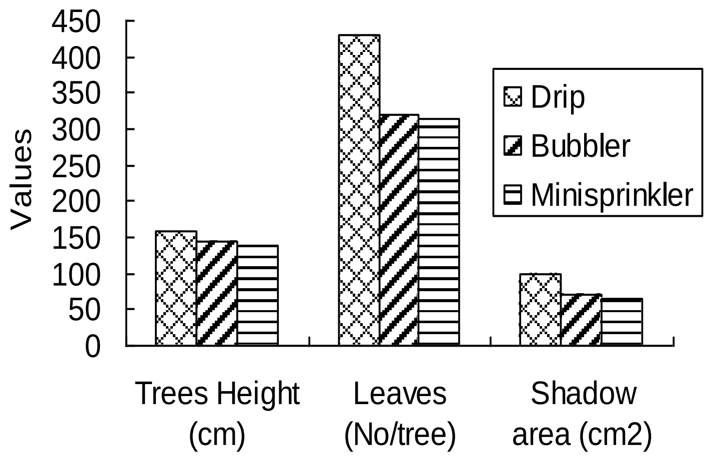

Fig (1): The effect of different MIS on some morphological characteristics of olive trees.

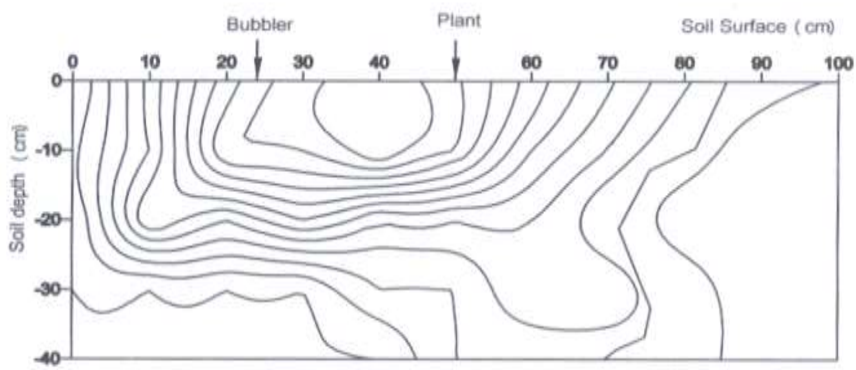

Fig (2): The effect of bubbler irrigation on olive root distribution.

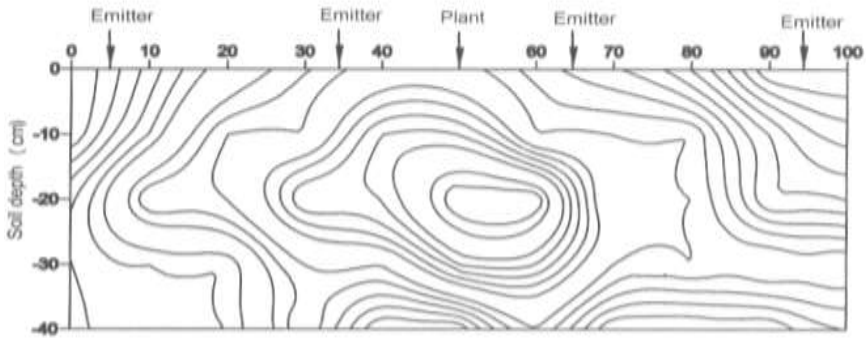

Fig (3): The effect of trickle irrigation on olive root distribution.

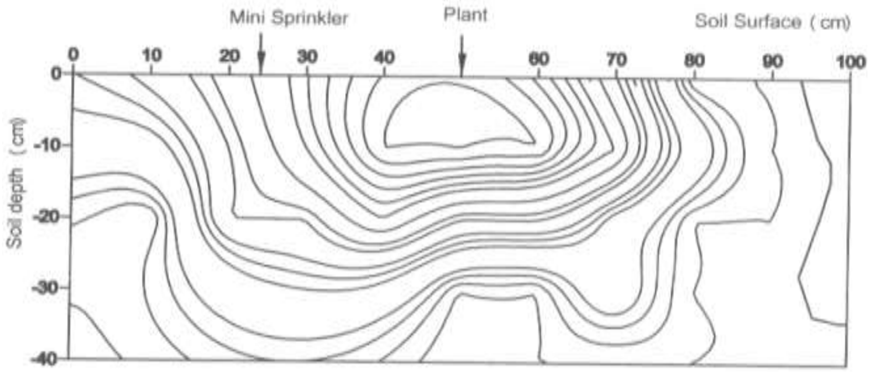

Fig (4): The effect of mini-sprinkler irrigation on olive root distribution.

4.3 Olive Yield

Table (4) and figure (5) show the average number of fruits/tree, fruit weight (gm), yield (kg/tree) and total yield (kg/fed) for olive as affected by MIS based on the average of the three studied seasons.

It's clear that MIS had a significant effect on the number of fruits/trees, fruit weight (gm), yield (kg/tree) and total yield (kg/fed) of olive considering average in the studied seasons. The number of fruits/tree is one of the parameters to be carefully considered, changes in this parameter will be directly reflected into the quantity and quality of the olive yield. Using trickle irrigation system increased the number of fruits per tree by 16 and 24% compared with bubbler and mini-sprinkler respectively.

Table (4): The effect of different MIS on the average number of fruits/tree, fruit weight (gm) yield (kg/tree), total yield (kg/fed) and yield efficiency (kg/fed).

MIS	Number of fruits/tree	Fruit weight (gm)	Yield (kg/tree)	Total yield (kg/fed)	Yield efficiency (m^3 /kg)
Trickle	22945.38	4.76	109.22	18348.96	0.09
Bubbler	19355.60	4.64	89.81	15088.08	0.11
Mini-sprinkler	17472.09	4.30	75.13	12621.84	0.14
"F" test	**	**	**	**	**
LSD at 0.01	0.019	0.070	0.041	0.017	0.004
LSD at 0.05	0.013	0.049	0.028	0.011	0.003

One of the parameters characterizing the quality of the olive fruits is the weight (gm), where the average of olive fruit weight was 4.76, 4.64 and 4.30 gm/fruit under trickle, bubbler and mini-sprinkler respectively.

Concerning yield (kg/tree) and (kg/fed), the results indicated that the highest value was obtained under trickle irrigation 109.22 kg/tree, with 18 and 32% as an increment from bubbler and mini-sprinkler respectively. The same trend for olive yield per feddan under trickle irrigation obtained the highest value 18348.96 kg/fed, while the lowest (12621.84 kg/fed) was obtained under mini-sprinkler irrigation system.

In general, the previous results lead to the conclusion that olive trees need enough irrigation water to keep the soil moisture at time of irrigation at the field capacity and good salt distribution in the soil layers.

Regarding yield efficiency (the amount of applied water per cubic meter that could produce one kilogram of olive fruits) as affected by MIS treatments the trickle irrigation system demonstrates more water saving for producing one kilogram of olive fruits with 18 and 35% less than with bubbler and mini-sprinkler respectively. These results are in accordance with those reported by Rugiero (1991), Abd El Aziz (1998) and Emtithal (2002) stated that the amount of water and method of irrigation and application of it are important for determining the cropping potential for apricots and oranges.

From the previous discussion, it can be concluded that, the changes in yield under each studied MIS treatment are mainly due to the effect of water distribution method which leads to good water distribution and compensates for moisture depletion from the root zone in the correct time to avoid water stress on the growing trees.

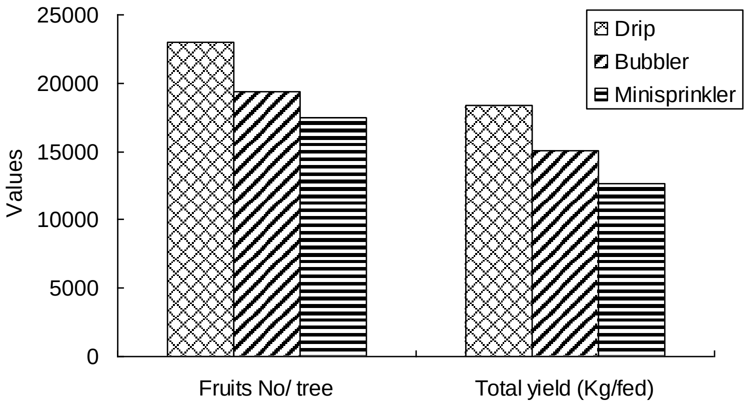

Figure (5): The effect of different MIS on olive yield.

4.4 Soil Moisture and Salt Distribution

This part of the study was concerned with the effect of different MIS irrigation systems on soil moisture and salt distribution in soils tested for olive trees cultivation (soil profile). This is done by determining the soil moisture content and the electrical conductivity of soil samples taken from different distances from the trunk of the tree and at three depths from the soil surface. The samples average results are presented in table (5) and illustrated in figure (6).

The results showed that the moisture content distribution pattern was greatly affected by the types of micro irrigation systems. The trickle irrigation system exhibited the highest moisture content compared with the other studied micro irrigation systems, where its moisture content ranged from about 18.19 to 16.66% by weight in the top (00-30) and (30-60)cm layers. At more than 60 cm the soil moisture decreased and reached 10.45% by weight. For the bubbler irrigation system, the soil moisture content was 16.66% by weight in the top layer (00-30)cm, while the deepest (60-90)cm layer had less moisture content than the field capacity. The mini-sprinkler irrigation system's moisture content ranged from 10.45 to 6.58% by weight which was less than the field capacity in the top 60 cm and which may be insufficient to meet the tree water demand at this period.

From the previous information, it could be concluded that the trickle irrigation system may give sufficient available water in the top layers (00-60) cm where the trees consume most of their water demand followed by bubbler and mini-sprinkler irrigation systems treatments.

Concerning the soluble salts distribution (EC dS/m), the data shown in table 5 and figure (7) revealed that the soil salinity was affected by the moisture distribution which was in turn governed by the studied three micro irrigation systems.

The soil salinity increased with the vertical distance from the emitter, bubbler or mini-sprinkler. The maximum values obtained under trickle irrigation was (2.73 dS/m) at the (60-90)cm, while the maximum values of the salinity were obtained at the bottom layer of the wetted zone in both bubbler and mini-sprinkler irrigation systems treatment (3.34 and 3.68 dS/m, respectively). In the mean time, the soil salinity in the main root zone was relatively low under the studied three micro irrigation systems.

These can lead to the conclusion that the olive tree growth and consequently yield production may not be greatly affected by the salinity but mainly by soil moisture distribution and availability.

Table (5): The effect of different MIS on soil moisture distribution (% by weight) and soil salinity (dS/m) distribution pattern under olive trees.

MIS	Soil layers depths (cm)	Soil moisture distribution (% by weight)	Soil salinity distribution (dS/m)
Trickle	00-30	18.19	0.79
	30-60	16.66	1.44
	60-90	10.45	2.73
Bubbler	00-30	16.66	0.88
	30-60	14.46	1.95
	60-90	9.01	3.34
Mini-sprinkler	00-30	10.45	0.93
	30-60	9.01	1.68
	60-90	6.58	3.68
"F" test		**	**
LSD of irrigation systems at 0.01		0.028	0.005
at 0.05		0.019	0.004
LSD of s Soil layers depths at 0.01		0.029	0.020
at 0.05		0.021	0.015
LSD of interaction at 0.01		0.050	0.035
at 0.05		0.036	0.026

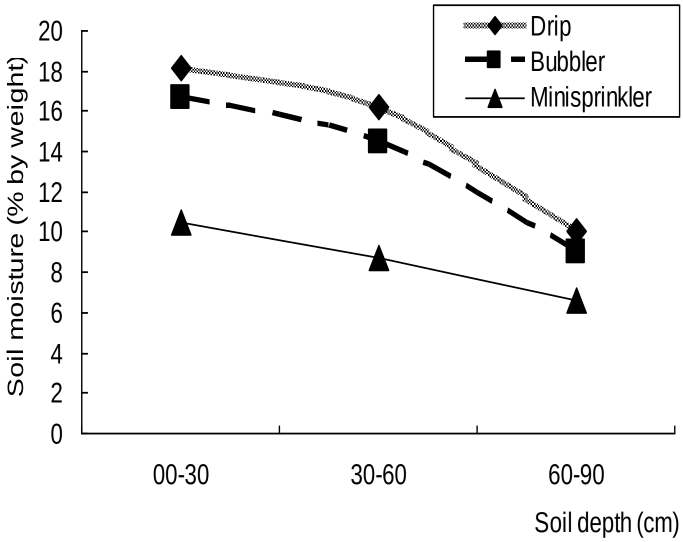

Figure (6): The effect of different MIS on soil moisture.

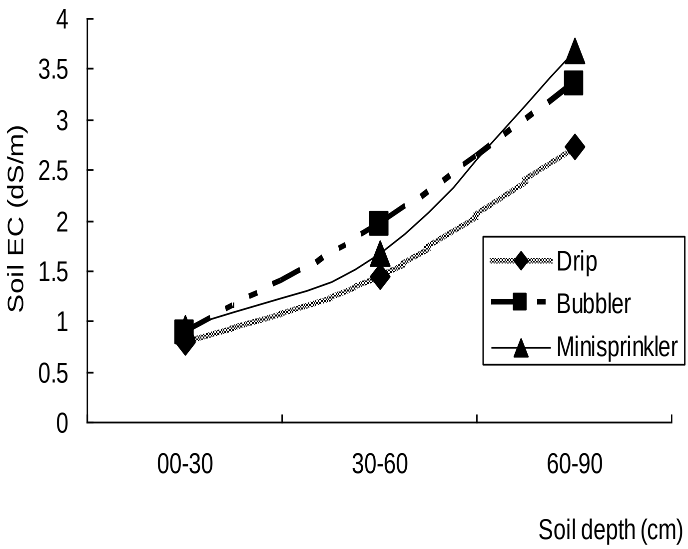

Figure (7): The effect of different MIS on soil salinity.

4-5 Statistical Analysis

Statistical analysis using the F test revealed a significant difference in each individual crop parameter by using trickle compared with bubbler and mini-sprinkler irrigation system.

CONCLUSION

When using different MIS irrigation systems (trickle, bubbler and mini-sprinkler) which apply different application irrigation methods the trickle irrigation systems could be considered as appropriate to maintain the best morphological characters for olive trees, good water uniform distribution, sufficient available moisture, acceptable soil salinity levels in the trees root zone, high yield and high yield efficiency. The application of irrigation water through trickle irrigation appears to be effective in minimizing irrigation water losses which in turn leads to an increase in yield efficiency. The water distributor's placement is the key factor in having good water uniformity in the olive trees root.

However, more intensive research is still needed to support such results in this field and some factors must be carefully under taken such as: the effect of using trickle irrigation after a long period, i.e. 7 years on the yield and the soil compared with the mini-sprinkler and bubbler; the effect of using self compensating emitters; the trickle placement i.e. in one or in two lines.

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الملخص العربي

مقارنة تاثير نظم رى موضعى مختلفة على اشجار الزيتون

د. عاطف نصار

نظم الرى الموضعى عديدة وهى عبارة عن فتحات ضيقة تخرج منها كميات صغيرة من المياة تحت ضغوط منخفضة الى النبات. والانواع التى استخدمت هنا للمقارنة فى هذة الدراسة هى الرى بالتنقيط والنافورى والرشاشات الصغيرة.

بدأت التجربة فى عام ٢٠٠٣ الى ٢٠٠٦ على مساحة ١٣ فدان بمحطة بحوث وادى النطرون التابعة لشعبة الرى الحقلى بمعهد بحوث ادارة المياة وطرق الرى وهى ذات تربة رملية تمثل اراضى غرب الدلتا. صممت التجربة بنظام القطع الطولية واستخدمت اشجار الزيتون صنف كلاماتا كدليل للمقارنة. زرعت النباتات فى ٢٠٠٣/٢/٨ فى جورة قطرها ١ متر بحيث يقع النبات فى منتصفها وزرعت على مسافات ٥ متر بين الاشجار ومثلها بين صفوف الاشجار. قسمت كل معاملة الى ٦ مكررات تعطى اجمالى ١٨ مكرر.

معهد بحوث إدارة المياه وطرق الرى . المركز القومى لبحوث المياه ,القاهرة . جمهورية مصر العربية

استخدم نفس المواصفات الفنية من معدات ومهمات الرى فى انواع الرى الموضعى المراد المقارنة بينها فاستخدم فى الوحدة الرئيسية لنظام الرى صمام عدم رجوع وعداد قياس للمياة ووحدة فنشورى للتسميد و و صمام هواء و صمام امان و ٣ عدادات لقياس الضغط اما الخطوط الرئيسية والفرعية فصممت على ان تكون سرعة المياة بداخلها ١,٥ م /ث. اما وحدات توزيع المياة المراد المقارنة بينهما فوزعت كالاتى: ١) فى نظام الرى بالتنقيط استخدم ٤ نقاطات ذات تصرف ١٢ لتر / ساعة والمسافة بينهما ٣٠ سم مركبة على خرطوم بولى اثيلين ١٦ مم بحيث تقع الشجرة بين نقاطين. ٢) فى نظام الرى النافورى استخدم نافورة واحدة ذات تصرف ١٠٠ لتر / ساعة وضعت على مسافة ٢٥ سم من ساق الشجرة بحث يتم تحريكها شهريا بزاوية ١٨٠ درجة مع عقارب الساعة لضمان جودة توزيع المياة حول الشجرة. ٣) فى نظام الرى بالرشاشات الصغيرة استخدم رشاش ذو تصرف ٧٠ لتر / ساعة ووضع على مسافة ٢٥ سم من ساق الشجرة بحث يتم تحريكه شهريا بزاوية ١٨٠ درجة مع عقارب الساعة لضمان جودة توزيع المياة حول الشجرة.

اخذت فى الاعتبار النقاط التالية عند المقارنة: النمو الخضرى للنبات (ارتفاع النبات, قطر الساق, عدد الافرع للشجرة, عدد الاوراق على الشجرة, مساحة الشجرة المظللة) وانتشارية جذور الشجرة . كما اخذ ايضا عامل الانتاج (عدد الثمار على الشجرة , وزن الثمرة الواحدة, وزن الثمار على الشجرة ووزن الانتاج الكلى على وحدة المساحة).

اوضحت النتائج ان هناك فائدة عظيمة عند استخدام الرى بالتنقيط حيث وجد ان هناك زيادة فى طول الاشجار(سم) تتراوح بين ١٠ و ٩,٢٪ وفى قطر الساق (مم) تتراوح بين ٦ و ١٤٪وفى عدد الافرع تتراوح بين ٨ و ١٤٪ وفى عدد الاوراق تتراوح بين ١٣ و ١٧٪ وفى المساحة المظللة (سم٢) تتراوح بين ٦ و ١٣٪ مقارنا مع نظام الرى النافورى وبالرشاشات الصغيرة على التوالى.

كما اظهرت النتائج ايضا ان المحتوى الرطوبى تحت نظام الرى بالتنقيط افضل من النظم الاخرى تحت الدراسة فقد كانت (١٨,١٩ و ١٦,٦٦ و ١٠,٤٥٪ وزن) فى طبقات التربة (٠٠-٣٠سم و ٣٠ – ٦٠سم و ٦٠-٩٠سم على التوالى) تحت نظام الرى بالتنقيط اما تحت نظام الرى النافورى فقد كانت كالاتى (١٦,٦٦ و ١٤,٤٦ و ٩,٠١٪ وزن) فى طبقات التربة (٠٠-٣٠سم و ٣٠ – ٦٠سم و ٦٠-٩٠سم على التوالى) اما الرى بالرشاشات الصغيرة فكان على النحو الاتى (١٠,٤٥ و ٩,٠١ و ٦,٥٨٪ وزن) فى طبقات التربة (٠٠- ٣٠سم و ٣٠ – ٦٠ سم و ٦٠-٩٠ سم على التوالى).

كما تبين ان انتشارية وتوزيع الجذور تحت نظام الرى بالتنقيط افضل من الرى النافورى وبالرشاشات الصغيرة ويعزى ذلك لتوزيع وتعدد وحدات توزيع المياة فى الرى بالتنقيط عن النوعين الاخرين تحت الدراسة.

واتضح ايضا ان اهم التأثيرات الايجابية للرى بالتنقيط توفير المياة المستخدمة فى انتاج واحد كيلو جرام من الزيتون بنسبة ١٨ و ٣٥٪ كما ان عدد ثمار الزيتون فى الرى بالتنقيط اعلا بنسبة ١٨ و ٢٤٪ وكذلك وزن الثمار على الشجرة (كجم / شجرة) اعلا بنسبة ١٨ و ٣٢٪ مقارنة بالرى النافورى والرشاشات الصغيرة. ولذلك ينصح باستخدام الرى بالتنقيط فى رى اشجار الزيتون بمنطقة وادى النطرون والتى تمثل منطقة غرب الدلتا.