IRRIGATION AND DRAINAGE
Prospects of Modern Technology in Agricultural Engineering and Management of Environmental Problems: 591 - 606

EFFECT OF USING A DRIP IRRIGATION SYSTEM INSTEAD OF FLOOD IRRIGATION SYSTEM ON THE MANDARIN PRODUCTIVITY IN THE OLD LANDS

AWWAD, A. H.*

ABSTRACT

The current investigation has been conducted during 2010-2012 seasons at Berkash -Giza Governorate, Egypt in heavy silt soil, to study the overall impact of replacement traditional irrigation system (flood irrigation system) with modern irrigation system (drip irrigation system) on the moisture distribution, yield productivity and water use efficiency of Mandarin trees. Two different ages of Mandarin trees (6 years and 10 years) during three seasons (one year after replacement, two years after replacement and three years after replacement) had been investigated in this study. The water was used as irrigation source having EC 0.80 mmhos/cm. Water use efficiency (W.U.E) under drip irrigation system (one year after replacement) decreased with the age of Mandarin trees 6 years (1.87kg/m^3) and the age of Mandarin trees 10 years (1.91 kg/m^3).On the other hand, under drip irrigation system (three years after replacement) increased with the age of Mandarin trees 10 years (3.16kg/m^3) than that of the age of Mandarin trees 6 years (2.78 kg/m^3) compared with (two years after replacement) with the age of Mandarin trees 10 years and the age of Mandarin trees 6 years which were 3.02kg/m^3 and 2.630kg/m^3 respectively. Generally under drip irrigation system (two years after replacement and three years after replacement) water use efficiency (W.U.E) increased with all treatments compared with flood irrigation system. Weeds density under drip irrigation system (between the rows of trees) was 9.25 g/m^2 far from emitters and increased under emitters to 33.5 g/m^2. In the same time, weeds density under drip irrigation system (between the columns of trees) was 8.17 g/m^2 far from emitters and increased under emitters to 34.0 g/m^2. While under flood irrigation system was 101.2 to 112.25 g/m^2 between the rows of trees and was 101.13 to 107.47 g/m^2 between the columns of trees.There were saving in the water applied under drip irrigation system compared with flood irrigation system by ratio 17.6% (960m^3). It is enough to irrigate another area equal to 896m^2 (0.21fedden).

*** Res. Agric. Eng. Res. Inst. A. R. C. Egypt.**

INTRODUCTION

There are many farms for orchards in irrigated depend on traditional irrigation systems in the desert areas, which leads to speed up the depletion of available groundwater in these areas in a short time and with uncertainty investors agricultural research results application of modern irrigation systems (drip irrigation) for the irrigation of orchards including contribute to the decreasing of water and increase the quality and quantity of the yield. Some of the farms in Delta use this system instead to the traditional system to take the risk of this replacement if they have a perfect method for the replacement process without incurring any risk affecting plants. **Anand et al (1999)** conducted among grape producers in Karnataka to determine the benefits and costs of irrigating grapes using surface or drip systems. Yields averaged 4.76 and 4.40 t/ha with drip and surface irrigation, respectively. Water used averaged 2330.55m^3 and 3732.12m^3, with drip and surface systems, respectively. **Helmy et al. (2000)** reported that increasing the applied water volume tends to increase the soil moisture content in both direction of vertical and horizontal under drip irrigation system and in vertical direction only under furrow irrigation system. **Shivakumar et al (2001)** studied the response of sunflower under varied levels of drip irrigation [drip irrigation] during the summer season in India. Four irrigation levels including drip at 0.5, 0.6 and 0.8 evaporation pan (Epan) and weekly surface irrigation at 0.8 Epan. Drip irrigation at 0.5 Epan recorded narrow wetting of 19 cm diameter at the surface to 12 cm at 30 cm soil depth. However, drip at 0.8 Epan wetted larger volume of soil with 27 cm diameter. Weekly surface irrigation caused maximum volume (110.92 cc) and dry weight (64.52 g). However, drip at 0.8 Epan volume (73.83 cc). Similarly, paired row planting recorded the maximum volume (100.58 cc). **Mady et al (2006)** reported that increasing the quantity of irrigation water applied to apple trees tended to increase the soil moisture content and decrease the soil salinity for all different depths. The maximum yield of apple (7900 kg/fed or 24.69 kg/tree) could be achieved by applying 33.8 L/tree.day (12 emitter per tree) at black plastic sheets. Meanwhile, the highest value of field water use efficiency (3.54 kg/m^3) has been obtained with 16.9 L/tree.day water applied and black plastic sheets. Meanwhile, the lowest value of FWUE (1.29 kg/m^3) was obtained with applying 33.8 L/tree.day and using bare soil treatment. **Panigrahi et al (2012)** reported that the scarcity of irrigation water is one of the major causes of low productivity and decline of citrus orchards and the drip irrigation (DI) could save a substantial amount of water over surface irrigation, besides improving the yield of citrus plants. The effects of DI and basin irrigation (BI) on soil chemical properties and crop responses were studied. DI was scheduled everyother- day at 40%, 60%, 80% and 100% of the alternate day cumulative evaporation (Ecp) measured in Class-A evaporation pan. DI except irrigation at 40% Ecp proved superior to BI, producing more growth and fruit yield of plants. The higher plant growth was recorded with higher regime of DI. The maximum fruit yield in DI at 80% Ecp, using 29% less irrigation water resulted in 111% improvement in irrigation water productivity under this treatment over BI.

The objective of the research was studying the overall impact of replacement traditional irrigation system (flood irrigation system) with modern irrigation system (drip irrigation system) on the moisture distribution, yield productivity and water use efficiency of Mandarin trees.

MATERIAL AND METHODS

The experiment was carried out under open field in heavy silt soil at Berkash -Giza Governorate during 2010 – 2012 to investigate the effect of replacement traditional irrigation system (flood irrigation system) with modern irrigation system (drip irrigation system) on soil moisture content, water use efficiency and yield productivity of Mandarin trees. Twelve different treatments were considered to evaluate two systems of irrigation during three consecutive seasons with two ages of Mandarin trees (6 years and 10 years). The treatments A1, A2 and A3 were recorded as flood irrigation system for 6 years trees old at one, two and three years after replacement respectively. But B1, B2 and B3 treatments were flood irrigation system for 10 years trees old at one, two and three years after replacement respectively. Also C1, C2 and C3 treatments were drip irrigation system for 6 years trees old at one, two and three years after replacement respectively. But D1, D2 and D3 treatments were drip irrigation system for 10 years trees old at one, two and three years after replacement respectively.

The first system was drip irrigation system using 8 l/h actual emitter discharge at operating pressure 1.0 bar for water application (3emitters/tree). The actual water applied (m^3) per season was 4500 m^3/fed/season. Irrigation schedule is showed in table (1). The distance between laterals and trees were four meters (4m*4m) according to the recommended spacing for Mandarin trees. The actual water applied (m^3) for Mandarin trees per season was 3250 m^3/season/plot (5460m^3/fed) for open field plots of 2500 m^2. (50m wide*50m long) according to the recommending spacing for Mandarin trees (4m*4m).

Table (1): Irrigation schedule of Mandarin trees

Months	No. of Irrigation (day)	Time of irrigation per hour	Water applied (L/tree/month)	Water applied (L/fed/month) (250 tree/fed)	Water applied (m^3/fed/month)
January	6	2.8	403.2	100800	101
February	9	3.72	803.52	200880	201
March	16	1.98	760.32	190080	190
April	16	4.31	1656	413900	414
May	16	5.39	2069.76	518000	518
June	15	6.92	2491.2	622800	623
July	15	6.81	2451.6	612900	613
August	16	6.45	2476	619000	619
September	16	4.32	1660	415000	415
October	10	6.66	1598.4	399600	400
November	9	3.75	810	202500	203
December	6	5.64	812.16	203040	203
Total	150 Day	58.75 Hours	-	-	4500 m^3/fed/season

The experiment composite soil samples were taken at the depths of 0-20, 20-40, 40-60, 60-80, 80-100 and 100-120cm. The physical and chemical properties of soil samples were determined according to the standard methods outlined by **Black (1983), Klute (1986) and Westerman (1990)** and the data of physical and mechanical properties of soil is listed in Table (2 and 3). The soil and water irrigation chemical analysis are presented in Table (4).

Table (2): Mechanical analysis of the experimental soil

Soil depth, cm	0-20	20-40	40-60	60-80	80-100	100-120
Silt,%	79.00	79.20	78.76	77.55	77.24	76.10
Clay,%	13.20	13.60	13.14	14.05	14.53	14.78
Sand,%	7.80	7.20	8.10	8.40	8.23	9.12

Table (3): Physical analysis of the experimental soil

Soil depth, Cm	pH	EC, Ds/m	$CaCo_3$	Cations Meq/L				Anions Meq/L			
				Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	Co_3^{--}	HCo_3^-	Cl^-	So_4^{--}
0-20	7.54	0.97	1.47	2.85	1.36	1.98	0.11	-	3.0	1.65	1.65
20-40	7.67	1.65	2.35	3.84	1.54	2.01	0.13	-	3.77	2.00	1.75
40-60	7.87	1.76	3.3	4.86	1.94	2.5	0.13	-	3.57	3.85	2.01
60-80	7.76	2.21	3.87	4.92	2.44	3.5	0.19	-	3.61	4.01	3.43
80-100	7.89	2.05	4.2	5.15	2.96	3.8	0.20	-	3.8	4.53	3.78
100-120	7.91	2.52	4.4	5.21	3.39	4.8	0.15	-	3.92	4.87	4.76

Table (4): Chemical analysis of irrigation water

Ph	EC,Ds/m	Cations Meq/L				Anions Meq/L			
		Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	Co_3^{--}	HCo_3^-	Cl^-	So_4^{--}
7.63	0.8	2.63	1.33	1.75	0.1	-	2.56	1.6	1.76

Representative soil samples were collected for analysis from each site at six depths of 0-20, 20-40, 40-60, 60-80, 80-100 and 100-120 cm.

Moisture distribution in the zone was measured using gravimetric method, **Michael (1978)** by collecting soil samples from the different top layers (0-20, 20-40, 40-60, 60-80 and 80-100 cm) at 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.0 m distances from the emitters (along the laterals) and at 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.0 m distance from the emitters (across the laterals).

Soil Salinity was measured by using electrical conductivity meter, mmohs/cm at 25co in 1 : 5 soil water extract sample as described by **Black (1965) and Jackson (1967).** The parameters used for assessing the salinity are namely Ca++ , Mg++, Na+, K+, Hco3 - , SO4 - and Cl-.

The soil profile has heavy silt soil through the entire profile. Calcium carbonate content ranged from 1.47 tò 4.4%. Water use efficiency (kg/m^3) was calculated according to **Michael, 1978** by using the following equation:

$$\text{Water use efficiency} = \frac{\text{Crop yield, kg/fed}}{\text{Water applied, m}^3\text{/ fed}}$$

RESULTS AND DISCUSSION

Moisture distribution

The variation in the wetted area, which represented moisture content values were high, may be attributed to factors related to, irrigation systems and flow rate of emitters. From experiment results and when comparing soil moisture content of drip irrigation treatments with flood irrigation treatments and after irrigation directly, this according to situation of taking soil samples in three directions from the source of emitters orifice. Which showed that the highest moisture content percentage in all treatments, which will be below emitters directly, and between laterals lines (between the rows), and getting less as from emitters orifice source as showed from Figs. (1, 2, 3 and 4).

On the other hand, under flood irrigation system the data showed that the highest moisture content percentage in all treatments, which will be obtained between the rows and the columns of trees as showed from Figs. (1, 2, 3 and 4). On the other hand, moisture profile distribution under drip irrigation system was varying. The moisture content generally decrease as the soil depth increase this is due to the nature of the investigated calcareous soil profile which the soil texture of surface layers. Under flood irrigation system (between the rows and the columns of trees) gave high moisture content percentage in all different soil profiles after irrigation directly, as showed Figs. (1, 2, 3 and 4) comparing with drip irrigation system which gave less values for moisture content as moisture content percentage. It was found that the highest moisture content percentage in all treatments, which will be below emitters directly, and between laterals lines.

Weeds density

Figure (5) showed that weeds density under drip irrigation system (between the rows of trees) was 9.25 g/m^2 far from emitters and increased under emitters to 33.5 g/m^2 and in the same time, weeds density under drip irrigation system (between the columns of trees) was 8.17 g/m^2 far from emitters and increased under emitters to 34.0 g/m^2 attributed to increase moisture content under emitters.

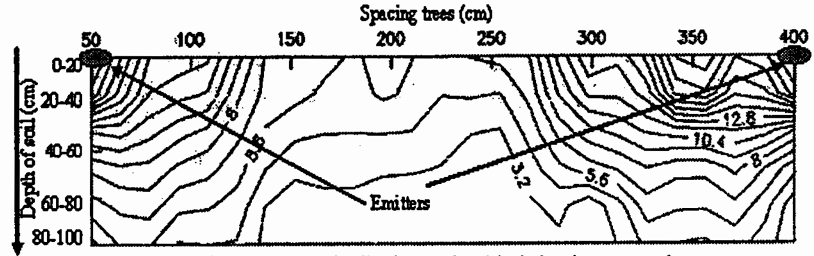

Fig. (1): Moisture profile distribution under drip irrigation system between trees.

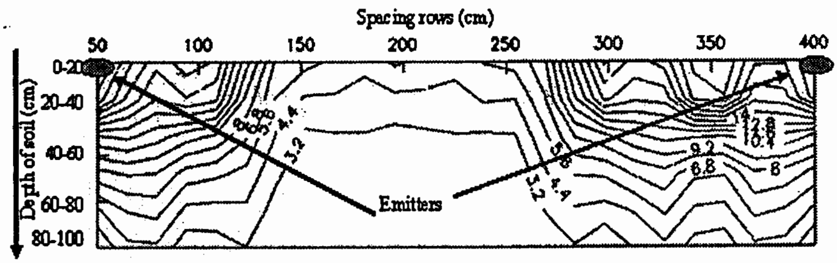

Fig. (2): Moisture profile distribution under drip irrigation system between rows.

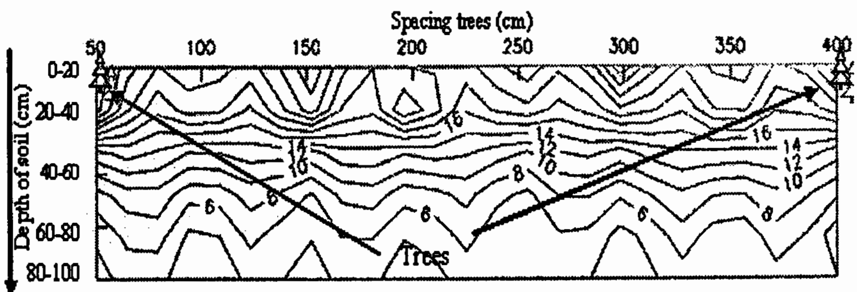

Fig. (3): Moisture profile distribution under flood irrigation system between trees.

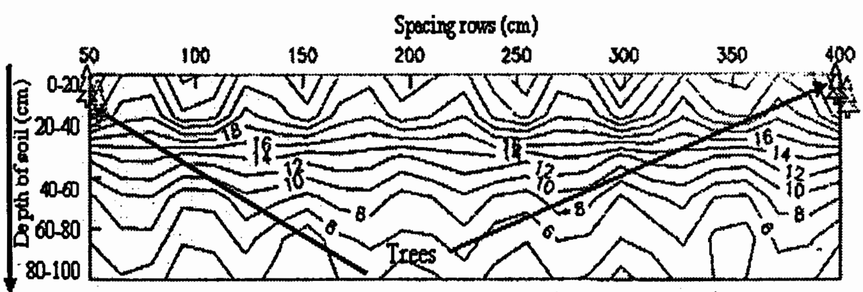

Fig. (4): Moisture profile distribution under flood irrigation system between rows.

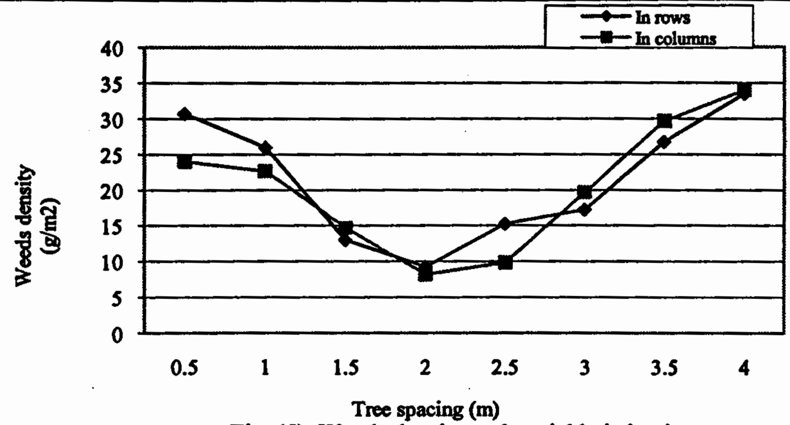

Fig. (5): Weeds density under trickle irrigation system

Figure (6) showed that under flood irrigation system was ranging from (101.2 g/m^2) to (112.25g/m^2) between the rows of trees and was ranging from (101.13 g/m^2) to (107.47 g/m^2) between the columns of trees attributed to increase moisture content in flood irrigation system.

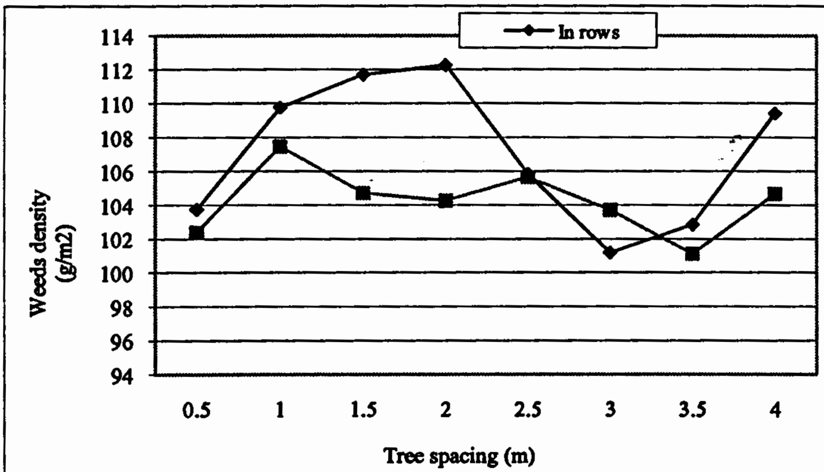

Fig. (6): Weeds density under flood irrigation system

Figure (7 and 8) showed that average weeds density under drip irrigation system (between the rows of trees) was 21.38 g/m^2 and increased to 106.73 g/m^2 under flood irrigation system due to increase the moisture content. On the other hand, average weeds density under drip irrigation system (between the columns of trees) was 21.10 g/m^2 and increased to

104.30 g/m^2 under flood irrigation system due to increase the moisture content too.

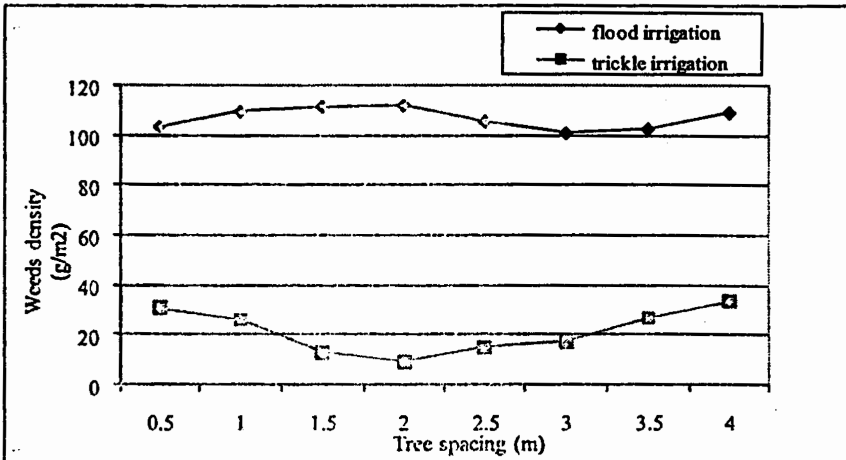

Fig. (7): Weeds density between the rows .

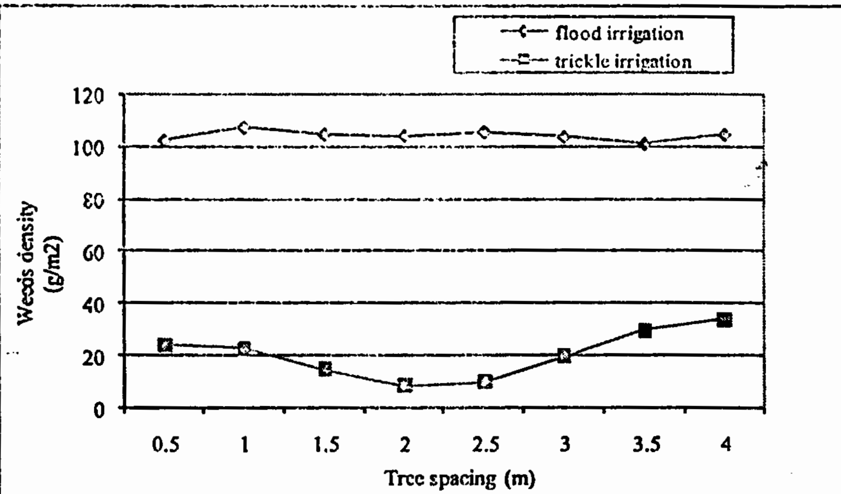

Fig. (8): Weeds density between the columns.

Moisture content of weeds

Moisture content of weeds (% of weight) under drip irrigation system (between the rows of trees) was 81.56% far from emitters and increased under emitters to 85.5%. In the same time, moisture content of weeds under drip irrigation system (between the columns of trees) was 79.5 far from emitters and increased under emitters to 84.8% due to increase the moisture content. While under flood irrigation system was ranging from (85.7%) to (87.2%) between the rows of trees and was ranging from (86.03%) to (86.93%) between the columns of trees due to more increase in the moisture content in the surface area.

Average moisture content of weeds in row spaces under drip irrigation system was 83.53% and increased to 86.45% under flood irrigation system. While, the average moisture content of weeds under drip irrigation system (in columns) was 82.15% and increased to 86.48% under flood irrigation system attributed to increase in the moisture content in the surface area.

Cost of mechanical and chemical resistant

Data in table (5) showed that the cost of mechanical average resistant during the season under drip irrigation system decreased compared with flood irrigation system by average ratio 59.4% with all treatments may be attributed to reduce the wetted area and the weeds density under drip irrigation system.

Table (5): Cost of mechanical resistant (labor and machines) under drip and flood irrigation system (£ /fed.)

Irrigation system	First mechanical Resistant		Second mechanical Resistant		Third mechanical resistant	
	Cost of machine (£ /fed.)	Cost of labor (£ /fed.)	Cost of machine (£ /fed.)	Cost of labor (£ /fed.)	Cost of machine (£ /fed.)	Cost of labor (£ /fed.)
Flood irrigation	120	200	Manual	250	120	50
Drip irrigation	Manual	150	Manual	100	Manual	50

Data in table (6) showed that average cost of chemical resistant (labor and material of chemical) during the season under drip irrigation system decreased compared with flood irrigation system by average ratio 41

%with all treatments may be attributed to reduce the wetted area and the weeds density under drip irrigation system.

Yields

The highest yield as shown in table 7 (two years and three years after replacement with drip irrigation system) was obtained in the treatment D3 (14199 kg/fed) than treatments D2, C3 and B2 since the yields were (13599 kg/fed, 13535 kg/fed and 12791 kg/fed respectively. The highest yield for these treatments could be attributed to reduced the competition which caused by weeds and high age of trees (10 years), Meanwhile, the lower yield was obtained from treatments (one year after replacement with drip irrigation system, C1 and D1) as 8427 kg/fed and 8600.5 kg/fed respectively may be caused by water regime in first year for replacement and still the competition which caused by weeds. Beside, There were drop of yield under flood irrigation system treatments compared with drip irrigation system treatments with (one year after replacement) may be attributed to increase the competition which caused by weeds and age of trees.

Table (6): Cost of chemical resistant (labor and machines) under drip and flood irrigation system (£ /fed.)

Irrigation system	Cost of chemical resistant (£ /fed.)	Cost of labor (£ /fed.)	Total cost of chemical resistant (£ /fed.)
Flood irrigation	535	75	610
Drip irrigation	310	50	360

Water use efficiency (W.U.E)

Water consumption efficiency (W.U.E) as shown in table 7 under drip irrigation system (one year after replacement) decreased with the age of Mandarin trees 10 years (1.91kg/m^3) and the age of Mandarin trees 6 years (1.87 kg/m^3) may caused of water regime in first year for replacement and still the competition which caused by weeds. However, under drip irrigation system (three years after replacement) increased with the age of Mandarin trees 10 years (3.16kg/m^3) than that of the age of Mandarin trees 6 years (2.78 kg/m^3) compared with (two years after replacement) with the age of Mandarin trees 10 years and the age of Mandarin trees 6 years which were 3.02kg/m^3 and 2.630kg/m^3 respectively due to the water regime and weeds density.

Table (7). Data of production with all treatments (Water use efficiency, yield, weight of one fruit, volume of one fruit) .

Treatments	Yield (kg/tree)	Yield (kg/fed)	Volume of one fruit (mm^3)	Weight of One fruit (gm)	Water use efficiency (kg/m^3)
A1	42.1	10526.9	86.31	100.80	1.93
B1	48.4	12091.9	96.21	109.30	2.21
C1	33.7	8427.0	72.30	80.50	1.87
D1	34.5	8600.5	77.61	85.37	1.91
A2	44.1	11012.8	90.30	102.30	2.02
B2	51.2	12791.4	98.20	107	2.34
C2	47.3	11825.0	147.80	146.30	2.63
D2	54.4	13599.0	168.70	158.70	3.02
A3	46.4	11595.9	93.40	100.70	2.12
B3	54.1	13535.3	100.98	102.30	2.48
C3	50.1	12529.5	150.10	162.40	2.78
D3	56.8	14199.0	175	173.30	3.16

Water use efficiency (W.U.E) as shown in table 7 under flood irrigation system (one year after replacement) increased with the age of Mandarin trees 10 years and the age of Mandarin trees 6 years (which were 2.21kg/m^3 and 1.93kg/m^3 respectively) than of the age of Mandarin trees 10 years and age of Mandarin trees 6 years under drip irrigation system (which were 1.91kg/m^3 and 1.87kg/m^3 respectively). Clearly, water use efficiency under drip irrigation system (two years after replacement and three years after replacement) increased with all treatments of flood irrigation system.

Data in table (7) showed that the average values obtained in treatments (D3, C3, D2 and C2) were 3/16 kg/m^3, 2.78 kg/m^3, 3.02 kg/m^3 and 2.63 kg/m^3 respectively, by using the same amount of irrigation water 4500 m3/fed. So water use efficiency increased in the treatment (D3) by ratios 12% and 4.5% and 16.77% than of the (C3, D2 and C2) respectively.

Generally, There were increasing of water use efficiency (W.U.E) under drip irrigation system treatments compared with flood irrigation system treatments may be attributed to reduce the competition which caused by weeds, the deference between amount of water applied with drip and flood irrigation system (4500 m^3/fed and 5460 m^3/fed respectively) and age of trees (except C1 and D1 which may be caused by water regime in first year for replacement and still the competition which caused by weeds.)

Quality of fruit

Only two parameter of quality for one fruit (volume and weight) and showed that the high volume and weight for one fruit was under drip irrigation system treatments compared with flood irrigation system treatments may be attributed to reduce the competition which caused by weeds and age of trees (except C1 and D1 which may be caused by water regime in first year for replacement and still the competition which caused by weeds).

CONCLUSOIN

Based on the results of this investigation, the following conclusion could be made:

1- Using the drip irrigation system in the open field for the old lands is better than flood irrigation system in view of the higher yield, since it increased 4.68% for the age of Mandarin trees 10 years after 3 years from the replacement and 7.45% for the age of Mandarin trees 6 years after 3 years from the replacement with an increasing water use efficiency of 21.52% and 23.74% respectively,.

2- Using the drip irrigation system in the open field for the old lands is better than flood irrigation system in view of the low cost of mechanical and chemical resistant by average ratio 59.4% and 41% respectively and also in view of the weeds density, since it decreased.

3-Saving in the water applied under drip irrigation system compared with flood irrigation system by ratio of 17.6% ($960m^3$) it is enough to irrigate another area equal to $896m^2$ (0.21fedden).

REFERENCES

Anand-TN; MT-Lakshminarayan; and BN-Manjunatha. (1999): Comparison of water consumption in grape cultivation under drip and surface irrigation system. Karnataka-Journal-of-Agricultural-Sciences. 1999, 12: 1-4, 214-215.

Black-CA; (1983). "Methods of soil analysis" part I and II. Amer. Agron. Inc. Publ., Madison, Wisc., USA.

Helmy-MA; SM-Gomaa; EM-Khalifa; and AM-Helal. (2000). Production of corn and sunflower under conditions of drip and furrow irrigation with reuse of agricultural drainage water. Misr. J. Ag. Eng., 17 (1):125-147.

Black- CA; (1965). "Methods of soil analysis" part I and II. Amer. Agron. Inc. Publ., Madison, Wisc., USA.

Jackson- ML; (1967). Soil chemical analysis. Prentice Hall, India:125 P.

Klute-A; (1986). Methods of soil analysis. Part 1. 2nd ed. ASA and SSSA. Madison.

Mady-AA; MA-Metwally; N-El-Dsoky; (2006). Moisture soil-salt distribution affecting apple yield under drip irrigation and mulching. Misr. J. Agric. Eng., 23 (2): 400-421.

Michael- A M; (1978). Irrigation theory and practice. Vikas pub. House PVTLTD New Delhi, Bombay. :360 p.

Panigrahi-P; AK- Srivastava; AD-Huchche; (2012). Effects of drip irrigation regimes and basin irrigation on Nagpur mandarin agronomical and physiological performance. Agricultural Water Management 104 (2012) 79– 88.

Shivakumar-HK; BK-Ramachandrappa; and HV-Nanjappa. (2001): Moisture and root distribution pattern under drip irrigation schedules and planting methods in sunflower. Crop-Research-Hisar. 2001, 21: 2, 143-147.

Westerman-RL; (1990). Soil testing and plant analysis. 3rd . Soil sc. Soc. of Am. Inc. Madison; Wisc. USA.

<u>**الملخص العربي**</u>

تأثيراستخدام نظام الري بالتنقيط بدلا من نظام الري بالغمر علي انتاجية اليوسفي في الاراضي القديمة

د. أمين حسين عواد*

تم إجراء هذا البحث خلال ثلاث مواسم متتالية ٢٠١٠-٢٠١٢ بمنطقة برقاش بمحافظة الجيزة، بمصر في التربة السلتية الطينية (السلتية الثقيلة) لدراسة تأثير استبدال نظام ري تقليدي (الري بالغمر) بنظام ري حديث (الري بالتنقيط) على توزيع الرطوبة والإنتاجية وكفاءة استخدام المياه لأشجار اليوسفي. حيث تم اختيار اثنين من أشجار اليوسفي ذات الأعمار (٦ سنوات و ١٠ سنوات) خلال ثلاثة مواسم بعد الاستبدال (سنة واحدة بعد الاستبدال وبعد عامين من الاستبدال و بعد ثلاث سنوات من الاستبدال) وملوحة المياه المستخدمة كمصدر للري كانت EC = ٠،٨ ملليموز/ سم. وأشارت النتائج إلى أن:

* باحث بمعهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – وزارة الزراعة .

١ - كفاءة استخدام المياه (WUE) تحت نظام الري بالتنقيط (بعد سنة واحدة من الاستبدال) انخفضت مع أشجار اليوسفي عمر ١٠ سنوات (١,٩١كجم/م٣) ومع أشجار اليوسفي عمر ٦ سنوات (١,٨٧ كجم/م٣) على التوالي. ومن جهة أخرى تحت نظام الري بالتنقيط (بعد ثلاث سنوات من الاستبدال) لوحظ زيادة كفاءة استخدام المياه (WUE) مع أشجار اليوسفي عمر ١٠ سنوات (٣,١٦ كجم/م٣) أكثر من أشجار اليوسفي عمر ٦ سنوات (٢,٧٨ كجم/م٣) مقارنة مع (سنتان بعد الاستبدال) مع أشجار اليوسفي عمر ١٠ سنوات و أشجار اليوسفي عمر ٦ سنوات والتي كانت ٣,٠٢ كجم/م٣ و٢,٦٣ كجم/م٣على التوالي. وعموما لوحظ زيادة كفاءة استخدام المياه (WUE) تحت نظام الري بالتنقيط (بعد سنتان وثلاث سنوات من الاستبدال) مقارنة بنظام الري بالغمر.

٢- كثافة الحشائش تحت نظام الري بالتنقيط (بين صفوف الأشجار) كانت ٩,٢٥ جم/م٢ بعيدا عن النقاطات وزادت إلى ٣٣,٥ جم/م٢ تحت النقاطات . في الوقت نفسه، كانت كثافة الحشائش تحت نظام الري بالتنقيط (بين أعمدة الأشجار) ٨,١٧ جم/م٢ بعيدا عن النقاطات وزادت إلى ٣٤ جم/م٢ تحت النقاطات. بينما تحت نظام الري بالغمر كانت كثافة الحشائش تتراوح بين (١٠١,٢ إلى ١١٢,٢٥ جم/م٢) بين صفوف الأشجارو تتراوح بين (١٠١,١٣ إلى ١٠٧,٤٧ جم/م٢) بين أعمدة الأشجار.

٣- كان هناك وفر في كميات المياه المضافة تحت نظام الري بالتنقيط مقارنة بنظام الري بالغمر بنسة ١٧,٦% (٩٦٠ متر مكعب) وهذه الكمية كافية لري مساحة تصل الي ٩٦٠ متر مربع (٠,٢١ فدانّ).