"New Trends in Agricultural Engineering": 1151- 1165. IRRIGATION AND DRAINAGE

IRRIGATION TECHNOLOGIES FOR IMPROVING SALT DISTRIBUTION, PEA PRODUCTION AND WATER RELATIONS

Nassar, A.A.* and Abou El Azem, A.M.*

ABSTRACT

A field experiment was carried out during winter season of 2005/2006 on Water Requirement Research Station at Bahteem region; EL Qalyubia Governorate, Egypt. Subsurface and surface trickle irrigation systems compared with modified furrow one were used in loamy soil. The aim of this work was to study the effect of modern irrigation technologies of water application method on improving salt distribution in the soil profile, fresh yield of pea (Pisum sativuml) and its water relations.

Results indicated that the soil salinity increased vertically from the line source or the emitter till it reached maximum values at the soil surface just above the line in the subsurface trickle irrigation systems, at the mid layers beneath the emitter in the surface trickle one and at the bottom of the wetted zone in both systems. Mean while it decreased at all studied layers through the soil profile under modified furrow irrigation system.

The subsurface trickle system treatment had significantly favored total fresh yield comparing with surface trickle and modified furrow treatments. The total fresh yields were 1660.0, 126.0 and 930.00 kg/fed with irrigation by subsurface trickle, surface trickle and modified furrow irrigation systems treatments respectively.

The subsurface treatment exhibited sufficient available water in the soil layers, where the plants consumed most of their water demand as well as surface trickle treatment, followed by modified furrow treatment. Whereas, the total amounts of water applied by subsurface, surface trickle and modified furrow treatments were 1669.36, 1679.97 and 2032.05 m^3/fed, respectively.

---

* Water Management and Irrigation Systems Research Institute, National Water Research Center, Cairo, Egypt.

Mean while, the corresponding values concerning the total water consumed by pea plants were 1546.97, 1511.20 and 1390.50 m^3/fed, in respective order.
Moreover, the highest water application efficiency (92.67%) was recorded by subsurface trickle irrigation system treatment. Also, this treatment gave the highest water use efficiencies for both crop water use efficiency 1.07 Kg/m^3 and field water use efficiency 0.99 Kg/m^3, respectively.

INTRODUCTION

Water is the most important factor in arid and semi arid regions using modern irrigation technologies such as subsurface and surface trickle and surface irrigation modified for improving soil salinity, vegetable productivity and its water relations. The best irrigation systems should give favorable crop yield, optimum use of water, minimum labor requirements and the least time consumed in field preparation and other agricultural practices. Saving water and reducing salt accumulation are very important in these regions.

Subsurface trickle appears to offer the best method of water uniform supplying in the root zone to the plant (Sammis 1980). EL Berry (1989) concluded that the subsurface trickle ensures high and efficient supply of water and fertilizers to plant at the effective root zone which is reflected in high yield. EL Berry et al; (1990) found that the use of subsurface trickle irrigation provided great potentials for vegetable production in arid area. In addition to higher expected yield, it reduced crop management costs and water demands.

Phene et al; (1993) reported that many commercial crops irrigated by subsurface trickle include tomato, potato, cantaloupe, strawberry, lettuce, cotton, sugarcane, grapes, hips, apple, almond, peach, walnut, pistachio and mango ornamentals. They also demonstrated hat the subsurface trickle maximized water use efficiency and yield of these crops, reduced evaporation at the soil surface and maintained constant soil water and caused upward hydraulic gradient to minimize deep percolation and NO_3^- N leaching.

Bakeer et al; (1996) noticed that the soil surface was clear from salts under subsurface trickle irrigation using at North Sinai. EL Morsy (1996) found that the soil salinity increased with both vertical and horizontal distance from leaky pipe or emitter and reached maximum values at the soil surface directly above the line in the subsurface trickle system and at the interface between trickle lines in the surface one as well as at the bottom of wetted zone in both systems. Significant higher yield was also obtained for the same system compared to surface trickling. Abo Solimon et al; (1996) revealed that EC values were decreased by about 4 and 11% for subsurface and surface trickle systems, respectively. Also they found slight decrease in amount of water irrigation values for tomato crop under subsurface trickle irrigation system as compared to surface trickle.

Pea (pisum sativum L) is considered as one of the most important vegetable crops in the world. Under Egyptian conditions, El Awady et al; (1975) indicated that the water use of 1000 m^3/fed, gave the highest yield of 2 ton / fed, of pea pods under trickle irrigation system. EL Mansi and El Beheidi (1977) reported that the water supply by trickle irrigation system at rate of 1684m3/fed enhanced the growth of pea plants. However, increasing water supply to pea plants enhanced the content and uptake of N and P quantity significantly, increased pea yield (Chouhan et al; 1992). EL Mansi et al; (1999) found that, application of 1200 m^3 water/fed, by trickle system gave the tallest plants, increased the uptake of N.P, average pod weight and total yield/fed. Decreasing the level of water supply (400 m^3/fed) increased water economy.

The objectives of the present investigation were to study the effect of modern irrigation technologies on improving salt distribution in the soil profile, fresh yield of pea (pisum sativum L) and its water relations.

MATERIALS AND METHODS

A field experiment was carried out during winter season of 2005/2006 on water requirement research station at Bahteem region, EL Qalyubia Governorate, Egypt to study the effect of modern irrigation technologies (subsurface trickle, surface trickle compared with modified furrow irrigation systems) on improving salt distribution in the soil profile fresh yield of pea

C.V. Little Marvel and its water relations (amount of irrigation water applied, consumptive use, water application efficiency and water use efficiencies for both crop and field).

Soil of experimental site was loamy in texture. Soil samples were collected to determine physical and chemical characteristics of the experimental site as initial. The average values of there measurements at different soil depths down to 60 cm and the chemical analysis of irrigation water are presented in table (1) according to standards of APHA (1989) and Peterson and Calvin (1965).

Table (1): Some physical and chemical properties of soil in initial stage and chemical of irrigation water.

Soil physical properties (%)							
Soil depth	Coarse sand	Fine sand	Silt	Clay	FC	PWP	AW
0 – 15	3.66	37.55	35.48	23.31	24.38	13.18	11.20
15-30	2.68	45.98	34.70	16.64	23.50	11.19	12.31
30-45	4.15	33.33	36.25	26.27	27.93	14.65	13.28
45-60	5.89	27.93	41.81	24.37	29.11	13.98	15.13

Soil chemical properties										
Soil depth	EC (dS/m)	CO_3^{--}	HCO_3^-	CL^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	SAR
0– 15	0.79	00	1.98	1.13	4.89	1.37	0.68	5.56	0.39	5.49
15-30	0.60	00	1.00	2.38	2.62	2.33	1.47	1.90	0.30	1.38
30-45	0.36	00	0.93	3.37	4.50	2.08	1.97	4.30	0.45	3.02
45-60	0.36	00	0.93	3.37	4.50	2.08	1.94	4.30	0.45	3.02

Water chemical properties									
EC (dS/m)	CO_3^{--}	HCO_3^-	CL^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	SAR
0.45	00	1.78	0.46	2.28	0.59	0.38	3.24	0.31	4.05

FC = Field Capacity, PWP = Permanent wilting point, AW= Available Water

The seeds were sown on October 25th, 2005 after inoculation with root nodules bacteria (Rhizobuim leguminosarum) and spaced at 30 cm apart on both sides of emitters lines in both subsurface and surface systems, and on both sides of furrow in modified furrow system (2 seeds/hill). Harvesting took place on the 21st of January 2006, each 5 to 6 days till approximately the end of March 2006 The normal practices for growing pea were followed as recommended for the region. Plot area was $250m^2$. It contains 33 ridges with 10m length and 75 cm distance. Three meters were left between each two irrigation systems treatments as a guard distance to avoid the overlapping or the interactions of irrigation water.

The experiment included three irrigation system treatments which were subsurface trickle, surface trickle and modified furrow irrigation systems. These treatments were arranged in randomized complete blocks with four replicates.

The types of emitters of both subsurface and surface trickle systems were GR which had 4 l/h discharge at pressure 1.0 bar and the depth of subsurface one was approximately 15cm. For the purpose of increasing the furrow water application uniformity, lightweight aluminum gated pipe was used. Small and easily adjusted gates with 75 cm apart between them, in the pipe facilitate control of the size of stream delivered to the furrow.

1. Salt Distribution in the soil profile

Salt distribution was determined as the difference between the mean values of the chemical analysis of soil samples extract before cultivation (initial state) after first irrigation and after end from successive depths (0-15), (15-30) and (45-60) cm under each studied irrigation system treatment. Electrical conductivity, soluble cations (Ca^{++}, Mg^{++}, Na^{+} and K^{+}) soluble anions (CO_3^{--}, HCO_3^{-}, and CL^{-}) and sodium adsorption ratio (SAR) were determined according to Jackson (1958). The sulfate anion was calculated by difference between the sum of cations and anions.

2. Fresh Yield

Green pods of each studied treatment were harvested at proper maturity stage and weighed in each harvest to calculate the yield per feddan.

3. Water Relations

3.1. Amount of Irrigation Water Applied

The irrigation water was applied according to requirement of the plants and shortage of the soil moisture contents, in order to raising the moisture content of the soil to its field capacity. For each irrigation system treatment, a water meter was used for measuring the amount of irrigation water applied. The depth of irrigation was calculated according to the equation given by Israelsen and Hansen (1962).

$$D_{aw} = (FC - \Theta 1)/100 \times D_b \times d$$
$$W_c = (\Theta 2 - \Theta 1)/100 \times D_b \times d$$

Where:

D_{aw} : Depth of applied irrigation water (mm).
W_c : water consumption.
F.C. : Soil moisture content at field capacity by weight (%).
$\Theta 1$:Soil moisture content before irrigation by weight (%).
$\Theta 2$: Soil moisture content after irrigation by weight (%).
D_b :Bulk density.
d :Soil depth.

3.2. Water Consumptive Use

It was determined as the difference in soil moisture content in the samples recorded at planting time, before and after each irrigation and at harvest time. Moisture contents in the soil samples were determined gravimetrically and calculated on dry weight basis, Garcia (1978). The quantities of water consumptive use were calculated according to the equation given by Israelsen and Hansen (1962).

3.3. Water Application Efficiency

It was calculated according to Michael (1978)

3.4. Water Use Efficiency Expressed as the Weight of Fresh Yield in kg/m^3

Water transpired and evaporated during the growing season was computed to evaluate water management practices. Both crop and field water use efficiencies were calculated according to Jensen (1983).

$$WUE_{crop} = \frac{\text{Seed. (kg/fed)}}{\text{Consumptive use. (m}^3\text{/fed.)}} = (\text{kg/m}^3)$$

$$WUE_{Field} = \frac{\text{Seed. (kg/fed)}}{\text{Applied water. (m}^3\text{/fed.)}} = (\text{kg/m}^3)$$

4. Statistical Analysis

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

RESULTS AND DISCUSSION

1. Salt distribution in the soil profile

Tables 1, 2, 3 and 4 depict the results of average chemical analysis of soil samples taken from soils irrigated by subsurface trickle, surface trickle and modified furrow irrigation systems treatments during the pea growing seasons.

The salt distribution in the soil profile as shown in that tables revealed that the soil salinity (EC dS/m) at the beginning and at the end of irrigation season was affected by the moisture distribution which in turn governed by both irrigation systems and amounts of irrigation water applied.

The soil salinity increased with vertical distance from the line source or the emitter and reached a maximum values (1.362 dS/m) at the soil surface directly above the line in the subsurface treatment and in the (30 – 45 cm) layer (2.466 dS/m) beneath the emitter in the surface trickle treatment as well as at bottom of the wetted zone in both systems (1.202 and 20217 dS/m, respectively). In the mean time, the soil salinity in the main root zone was relatively low. It can lead to conclude that the plant growth and consequently production may be not greatly affected by the salinity but mainly by soil moisture distribution and availability in other words, the data show that the salinity decreased in the soil profile irrigated by modified furrow irrigation systems treatment, where it decreased by increasing the amount of irrigation water. Therefore the accumulated salts can be easily leached out with additional irrigation water. The same trend was approximately obtained by Abou Soliman et al; (1996) and Abou EL Azem et al; (2002).

Most of salt distribution in the soil profile under each irrigation systems was a sodium sulfate. Moreover, SAR values followed the same trend of EC, Na^{+} and SO_4^{--} .

Table (2): Average soil chemical analysis values after first and last irrigation of pea crop as affected by subsurface trickle irrigation system treatment

Sampling time	Depth (cm)	EC (dS/m)	Anions (meq/l)			Cations (meq/l)				SAR
			HCO_3^-	CL^-	SO_4^{--}	K^+	Na^+	Mg^{++}	Ca^{++}	
After first irrigation	00-15	0.797	0.37	1.96	3.66	2.48	1.91	3.02	0.58	2.04
	15-30	0.681	2.11	1.37	3.32	2.03	1.68	2.35	0.69	1.71
	30-45	0.949	1.98	3.10	4.45	2.88	1.87	3.97	0.78	2.58
	45-60	0.856	2.09	2.96	3.49	2.58	2.18	3.07	0.73	1.99
After last irrigation	00-15	1.362	3.52	2.82	7.30	3.55	1.76	7.96	0.37	4.89
	15-30	1.166	3.97	2.71	5.96	2.60	1.37	7.19	0.48	5.10
	30-45	1.233	3.68	2.63	5.99	2.00	1.79	7.60	0.91	5.52
	45-60	1.202	3.60	1.98	6.42	1.75	1.26	7.89	1.10	5.24

Table (3): Average soil chemical analysis values after first and last irrigation of pea crop as affected by surface trickle irrigation system treatment

Sampling time	Depth (cm)	EC (dS/m)	Anions (meq/l)			Cations (meq/l)				SAR
			HCO_3^-	CL^-	SO_4^{--}	K^+	Na^+	Mg^{++}	Ca^{++}	
After first irrigation	00-15	0.703	1.00	2.57	3.43	1.33	1.00	4.04	0.63	3.74
	15-30	1.021	1.10	3.78	5.34	1.85	1.28	6.11	0.98	4.88
	30-45	0.832	0.95	3.00	4.35	1.77	0.97	4.99	0.57	4.26
	45-60	0.843	0.99	2.49	4.97	1.86	0.99	5.20	0.40	4.36
After last irrigation	00-15	0.865	1.38	2.61	4.68	1.37	1.10	5.50	0.70	4.95
	15-30	1.288	0.93	4.86	7.11	2.33	1.67	7.84	1.06	5.54
	30-45	2.466	0.80	8.95	14.91	3.57	1.85	17.95	1.29	10.90
	45-60	2.217	0.99	6.66	14.50	3.10	1.77	16.38	0.90	10.50

Table (4): Average soil chemical analysis values after first and last irrigation of pea crop as affected by modified furrow irrigation system treatment

Sampling time	Depth (cm)	EC (dS/m)	Anions (meq/l)			Cations (meq/l)				SAR
			HCO^-_3	CL^-	SO^{--}_4	K^+	Na^+	Mg^{++}	Ca^{++}	
After first irrigation	00-15	0.455	0.70	1.00	2.87	1.38	0.95	2.04	0.20	1.89
	15-30	0.482	0.92	1.10	2.78	1.46	0.97	2.12	0.25	1.92
	30-45	0.547	0.98	1.50	2.97	1.53	1.13	2.38	0.41	2.06
	45-60	0.993	1.37	163	6.91	2.41	1.69	5.12	0.69	3.58
After last irrigation	00-15	0.332	0.56	0.73	2.05	0.98	0.61	1.65	0.10	1.85
	15-30	0.400	0.61	0.77	2.64	1.31	0.73	1.90	0.08	1.88
	30-45	0.455	0.84	0.90	2.83	1.40	0.96	2.16	0.05	1.99
	45-60	0.547	1.00	1.18	3.27	1.53	1.11	2.76	0.05	2.40

2. Fresh Yield

Pea fresh yield as affected by modern irrigation technologies of water application method, are presented in table 5.

The data revealed that fresh yield of pea was significant affected by all the studied treatments. The total fresh yields were 1660.0, 1265.0 and 930.0 kg/fed for the treatments irrigated by subsurface trickle, surface trickle and modified furrow irrigation systems, respectively the higher fresh yield was obtained for the treatment irrigated by subsurface trickle irrigation system compared to the other two irrigation system treatments. On the contrary, the lowest fresh yield was obtained for the treatment irrigated by modified furrow irrigation system. These trends are in agreement with those obtained by Abou EL Azem et al; (2002).

The previous results lead to the conclusion that, the higher fresh yield for subsurface trickle irrigation system treatment could be attributed to the uniform distribution of sufficient available water and fertilizers directly in the root zone. Meanwhile, the lower fresh yield obtained from modified furrow irrigation system treatment may be attributed to the insufficient water to reach the root zone in particular early growth stage where a small root system could not extend enough to reach the water. The upward movement of applied water may be very limited to meet the plants demand.

3. Water Relations

3.1. Amount of Irrigation Water Applied

The amount of water applied to pea crop under the irrigation system treatments are presented in table 5.

The data revealed that, the total amount of irrigation water applied under both subsurface and surface trickle irrigation systems were almost similar while was greater under modified furrow irrigation system than both systems. The irrigation water amount of subsurface, surface trickle and modified furrow irrigation systems were 1669.36, 1679.97 and 2032 m^3/fed, respectively.

Table (5): Fresh yield, amount of irrigation water consumptive use, water application efficiency and water use efficiencies for both crop and field of pea crop as affected by irrigation systems treatment.

Treatment Character	Subsurface Trickle irrigation system	Subsurface Trickle irrigation system	Modified furrow irrigation system	"F" test	L.S.	
					at 0.05	at 0.01
Fresh yield (kg/fed)	1660.0	1265.0	930.0	**	10.70	7.06
Amount of irrigation water applied (m3/fed)	1669.36	1679.97	2032.0	**	11.36	7.50
Water consumptive use (m3/fed)	1546.97	1511.20	1390.50	**	11.33	7.48
Water application efficiency (%)	92.67	89.95	68.43	**	0.68	0.45
Crop water use efficiency (kg/m^3)	1.07	0.84	0.67	**	0.06	0.04
Field water use efficiency (kg/m^3)	0.99	0.75	0.46	**	0.06	0.04

The results indicated that saving water (17.85 and 17.32% through irrigating with subsurface and surface trickle instead of modified furrow irrigation systems, respectively. Similar conclusion was reported by EL Said A.EL Morsy (1996) for tomatoes irrigated by subsurface and surface trickle irrigation systems.

From the previous discussion, it can be concluded that the changes in fresh yield under each studied irrigation system treatment are mainly due to the effect of not only how much water was applied but also how water was applied (modern irrigation technologies of water application method), where the amounts should have a good distribution on the soil to be sufficient to replace moisture consumed from the root zone to avoid water stress on the growing plants.

3.2. Water Consumptive Use

Water consumptive use values for pea crop as affected by irrigation system treatments during the growing season are presented in table 5.

The total water consumptive use values of crop were 1546.97, 1511.20 and 1390.50 m^3/fed under subsurface trickle, surface trickle and modified furrow irrigation systems treatments, respectively. The highest value of water consumptive use was obtained with the subsurface trickle irrigation system treatment followed by the surface trickle one. While the lowest value was obtained with the modified furrow irrigation system treatment.

It is clear from the previous results that the value of water consumptive use of pea plants under subsurface trickle irrigation system treatment was higher than under surface one and modified furrow irrigation systems treatments with the same condition. This could be due to that the evaporation from the soil surface under subsurface trickle was less than under the other both systems, thus the values of water consumed increased by pea plant under it.

3.3. Water Application Efficiency

Water application efficiency of pea plants as affected by modern irrigation technologies of water application method in the studied growing season are presented in table 5.

The results demonstrate clearly that the water application efficiencies of pea plants irrigation by subsurface trickle irrigation system treatment (92.67%) was higher than the other treatments. While it was for irrigation by modified furrow irrigation system treatment (68.43%) lower than the other one. The water application efficiencies values were 92.67, 89.95 and 68.43 % for subsurface trickle, surface trickle and modified furrow irrigation system treatments, respectively. This increase in the water application efficiency could be mainly due to the decrease of water losses. This indicated that surface trickle and modified furrow irrigation systems treatments water application efficiencies decreased by increasing the water losses by evaporation from the soil surface and deep percolation outside the effective root zone.

3.4. Water Use Efficiency

Efficiencies of water use for crop and field as affected by the modern irrigation system of pea crop are presented in table 5.

Higher values of crops and field water use efficiency (1.07 and 0.99 kg/m^3 respectively) were obtained under subsurface trickle irrigation system. While the modified furrow irrigation system treatment induced lower values (0.67 and 0.46 kg/m^3 for pea respectively). The water use efficiencies values were 1.07, 0.84, 0.67, 0.99, 0.75 and 0.46 kg/m^3 for pea irrigated by subsurface trickle, surface trickle and modified furrow irrigation systems treatments, respectively.

It can be concluded that the irrigation of pea by subsurface trickle irrigation system is the best treatment. This treatment resulted in more water saving and achieved good production of fresh yield.

CONCLUSION

When using modern irrigation technologies of water application (subsurface trickle, surface trickle and modified furrow irrigation systems), the subsurface trickle irrigation system is appropriate to maintain uniform distribution and sufficient available moisture and acceptable salinity level directly in the plant root zone. The water application efficiency through such system appears to be affected by minimizing irrigation water losses due to the evaporation from soil surface and deep percolation outside the effective root zone.

REFERENCES

Abou Soliman, M.S., H.A. Shams EL Din, S.A. Hassanein and M.H. Hegazy (1996). Water management for tomatoes production under protected cultivation. Misr, J. Agric. Eng. Cairo Univ. Irr. Conf. 3.4 April 1996: 101-110.

Abou EL Azem, A. M.; T.M. Husien and A.A. Nassar (2002) subsurface trickle irrigation system management for vegetables production. Egypt. J. Appl. Sci., 17(12) : 425 – 448.

APHA, American Public Health Association (1989). Standard methods for examination water and wastewater, Washington DC, 17th ed.

Bakeer, G.A.; F.G. EL Ebabi and A.M. EL Berry (1996). Subsurface drip irrigation management for vegetable production at North Sinai. Misr, J. Agric. Eng., Cairo univ. Irr. Conl – 3-4 April 1996.

Chouhan, D.K. , K.S. Pan War and R.S. Balyan (1992). Influence of irrigation, phosphorus and weeds on yield pea (Pisum sativum L). Tropical Pest Management, 38 (1): 1-4 [C.F. Field Crop. 45, (11): 7816].

EL Berry, A.M.; E. Hanafy and M.H. Ahmed (1990). Utilization of Bi-wall subsurface drip irrigation system for vegetable production under desert conditions. Misr, J. Agric. Eng. Egypt, 7 – 23.

EL Mansi, A.A. and M.A. Beheidi (1977). Effect of irrigation frequency on the growth and yield of peas. Zagazig. J. Agric. Res., 4 (1): 133-151.

EL Mansi, A. H.; M. E. Arisha, A. Bardisi and E. M. Nour (1999). Studies on some factors affecting growth and yield of pea under some soil conditions using drip irrigation system. 1-Effect of sowing date and irrigation water quality. Zagazig. J. Agric. Res., Res. 26(5): 1385 – 1407.

EL Morsy, A. (1996). Tomatoes response to subsurface leakage irrigation with saline water. Misr, J. Agric. Eng., Cairo Univ. Irr. Conf., 3-4 April 1996.

Garcia, I. (1978). Soil water Laboratory Manual. Dept. Agr. and Chemical Engineering. Colorado state Univ., Fort Collins, Colorado. U.S.A.

Israelsen, O.W. and V.E. Hansen (1962). Irrigation principle and practices 3rd ed. Willey and Sons. N. Y: 200-220.

Jackson, M.L. (1958). Soils chemical analysis, Prentice Ha Inc., Cliffs, N. J., U.S.A.

Jensen, M.E. (1983). Design and operation of farm irrigation systems. Amr. Soc. Agric. Eng. Michigan, U.S.A. Martinez Hemandez, J.J., B bar Yosef.

Micheal, A. M. (1978). Irrigation theory and practices. Vikas Publishing House, New Delhi. Bombay.

Peterson, R.G. and L.D. Calvin (1965). Sampling JNCA Bla (ed) methods of soil analysis. Soc. Agron. 9 Madison WI. Agron. 9: 54-71.

Sammis, T.W. (1980). Comparison of sprinkler, trickle, subsurface and furrow irrigation methods for raw crops. Agron. J., 72: 701 – 704.

Snedecor, G.W. and W.G. Cochran (1980). Statistical methods. 7th Iowa Univ., Press, Amer. Iowa U.S.A.

الملخص العربي

تكنولوجيا الري لتحسين توزيع الأملاح وإنتاجية البسلة وعلاقاتها المائية

عاطف نصار* **عبد الله أبو العزم***

أجريت هذه الدراسة بمحطة تجارب المقننات المائية ببهتيم بمحافظة القليوبية - جمهورية مصر العربية خلال الموسم الشتوي ٢٠٠٥/٢٠٠٦ باستخدام نظامي الري بالتنقيط تحت السطحي (على عمق ١٥سم) والسطحي مقارنة بنظام الري بالخطوط المطور (باستخدام المواسير ذات البوابات وذلك لدراسة تأثير تقنيات الري الحديثة على تحسين توزيع الأملاح في قطاع التربة، والمحصول الأخضر، والعلاقات المائية من حيث كمية مياه الري المضافة والاستهلاك المائي وكفاءة إضافة مياه الري وكفاءة استخدام مياه الري لكل من المحصول والحقل لمحصول البسلة فى الأراضي الطميية. وقد تمت زراعة محصول البسلة واستخدام القطاعات الكاملة العشوائية في أربعه مكررات ونفذت فى ثلاثة معاملات واستخدمت فيها نظم الرى الحديثة التالية:

* معهد بحوث إدارة المياه وطرق الرى - المركز القومى لبحوث المياه - جمهورية مصر العربية

المعاملة الأولى: التنقيط تحت سطحي.
والمعاملة الثانية: التنقيط السطحي.
والمعاملة الثالثة: استخدم فيها نظام الري بالخطوط باستخدام المواسير ذات البوابات.

أظهرت النتائج إن تركيز الأملاح يزداد رأسياً في قطاع التربة تحت نظامي الري بالتنقيط حتى يصل إلى أقصى تركيز فوق مصدر الري تماماً تحت نظام الري بالتنقيط التحت سطحي وفى الطبقة المتوسطة تحت النقاطات فى نظام الري بالتنقيط السطحي وفى قاع منطقة الابتلال في كليهما، فى حين تقل الملوحة باستمرار باستخدام نظام الري بالخطوط المعدة لحدوث غسيل مستمر لقطاع التربة كنتيجة لزيادة كميات مياه الري المضافة وإن زاد تركيز الأملاح بالزيادة في عمق قطاع التربة.

كما أوضحت النتائج أن معاملة نظام الري بالتنقيط تحت سطحي أعطت زيادة معنوية في الإنتاجية الخضراء لمحصول البسلة حيث سجلت ١٦٦٠كج/فدان فى حين سجلت معاملة نظام الري بالتنقيط السطحي ١٢٦٥كجم/فدان ، وسجلت معاملة نظام الري بالخطوط المعدل أقل إنتاجية وهى ٩٣٠كج/فدان.

كما أوضحت النتائج تناقصاً معنوياً فى كمية مياه الري المضافة لمعاملتي الري بالتنقيط التحت سطحي والسطحي على الترتيب عن تلك المضافة بنظام الري بالخطوط المطور حيث كانت كميات مياه الري المضافة كالتالي ١٦٦٩,٣٦، ١٦٨٩,٩٧ ، ٢٠٣٢,٠٥م٣/فدان على الترتيب، فى حين سجلت كميات مياه الري المستهلكة بنباتات البسلة المروية بنظامي الري بالتنقيط التحت سطحي والسطحى على الترتيب عن تلك لمروية بنظام الري بالخطوط المعدل حيث كانت كمية الاستهلاك المائي لنباتات محصول البسلة ١٥٤٦,٩٧، ١٥١١,٢٠، ١٣٩٠,٥٠ م٣/فدان على الترتيب.

كذلك أوضحت النتائج أن معاملة نظام الري بالتنقيط التحت سطحي قد سجلت أعلى كفاءة إضافة مياه الري (٩٢,٦٧%) تليها معاملة نظام الري بالتنقيط السطحي (٨٩,٩٥%) (فى حين سجلت معاملة نظام الري بالخطوط المعدل أقل كفاءة إضافة مياه الري (٦٧,٤٣%).

وكذلك أظهرت النتائج أن كفاءة استخدام مياه الري لكل من المحصول والحقل مقدرة بالكيلو جرام حبوب خضراء لكل متر مكعب ماء كاستهلاك مائي أو ككمية مياه رى مضافة قد ازدادت معنوياً أيضا مع نقص المحتوى الرطوبى فى التربة الناشىء عن استخدام نظام الري بالتنقيط التحت سطحي ونظام الرى بالتنقيط السطحي وذلك بالمقارنة بنظام الرى بالخطوط.