Misr J. Ag. Eng., 26(3): 1318- 1335 IRRIGATION AND DRAINAGE

PERFORMANCE ANALYSIS OF SELF – COMPENSATING GATED PIPE FOR IMPROVING SURFACE IRRIGATION EFFICIENCY

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ABSTRACT

Rationalizing irrigation water and maximizing water use efficiency became the priority of irrigation planners and users under Egyptian conditions. Therefore, the aim of this study was to evaluate adjusted of self-compensating gated pipe for modified surface irrigation and to evaluate the pepper yield response and water use efficiency under three irrigation system (drip irrigation ,traditional gated pipe and modified gated pipe) and three water treatments (100, 75 and 50% of ETC) in old land conditions of Egypt. Hereby field experiments were carried out at the Experimental Farm of Faculty of Agriculture, Ain Shams University, Kalubia Governorate, which represents alluvial soils, for two successive growing seasons 2006 and 2007. Results revealed that. In laboratory experiments of self-compensating gated pipe out let average discharge from 29 L/min were obtained at pressure range of (2 – 9 kPa) with coefficients of variation less than 0.9%. Uniform discharge was obtained at modified gated pipe under pressure range of 45-90 cm. Corresponding field data were similar to laboratory data. Regular uniform water flow from gates and regular uniform pressure head from each outlet was obtained along line at modified gated pipe under constant pressure. Regular advance times approximately was obtained in modified gated pipe along furrows (0.6, 1.5, 2.6, 4, 5.4 and 6.7 min) at the first furrow and (0.7, 1.7, 3, 4.5, 6.2 and 7.7 min) in the end furrow at distance in meter (4, 8, 12, 16, 20, 24 m) respectively the same trend of recession

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time (min).Uniformity coefficient of distribution (CUD) along traditional and modified gated pipe was 82.7% and 96.3%, respectively. The highest total fresh pepper fruit yields (14319.5 kg/fed) with 75% of ET_C under modified gated pipe, respectively. Water use efficiency treatment 50 % of ET_C under drip irrigation was the superior in WUE (5.7 kg/m^3).

INTRODUCTION

Nile Valley and Delta soils are mainly irrigated based on surface irrigation system which is with quiet low efficiency that ranged of about 47 up to 50%. Due to limited water resources, arid climate and fast increasing of in population, more water is required for eliminating the demand available balance gape. Therefore, developing surface irrigation by using gated-pipes technique provides an important tool to improve its performance. Uniform water flow may be regulated by adjusting the size of the outlet opening manually with some difficulties, which may be reducing water application. **Osman, 2000** mentioned that good design of gated pipes with precision land -leveling may improve the water distribution uniformity and save irrigation water by about 12 and 29 % in cotton and wheat, resp. **El-Sayed, 1998** found

that the required head to efficiency. Short flexible sieves may be attached to the outlets to dissipate energy and minimize erosion at furrow inlets. Operate the GP is 50 cm or less under alluvial soil conditions. **El-Gindy et al., 2000** found that by using gated pipe, irrigation significantly affected fruit shape homogeneity and specific weights of fruit and pericarp. **Osman, 2003** conducted two field experiments for two growing seasons (2000 and 2002) to investigate the response of field crops and old Mango farm to the modified surface irrigation system with gated pipes comparing with traditional, to determine the actual water requirements and economical efficiency, for some field crops such as cotton, wheat, corn and rice crops. Results indicated that by using gated pipes, the highest cotton, wheat, corn and rice yield, were obtained (61.1, 65.2, 116 and 53.6 %) when compared to the traditional irrigation system. Meanwhile, water saving was (29.64, 29.9, 14.5 and 19.7 %) in cotton, wheat, corn and rice compared with traditional (flooding) system. Water use efficiencies for an improved surface irrigated cotton, wheat; corn and rice were higher than traditional system, by (129, 137, 154.4 and 79.4 %), respectively. The same results showed that using gated pipes obtained the highest mango yield by 37.2% technique. Also, water was saved by 19.8% in mango compared with traditional system. Water utilization efficiency by using improved surface irrigated mango with gated pipes, increased by 70.7% compared with traditional system. **El- Awady et al., 2004** stated that the hydraulics characteristics of rectangular – gated pipes were studied by observing the distribution uniformity of flow, pressure along pipe and the discharge coefficient for the gate. Results included: (1) laboratory work to calibrate sliding gates under different pressures, outlet areas and discharge coefficients, (2) theoretical determination of suitable outlet area to give high distribution uniformity by a new mathematical approach, and (3) field work to examine the results under calculated outlet areas along 6" (150 mm) gated pipe. Results also showed great agreement the theoretical gated pipe flow rate, based on newly derived equation and the corresponding fieldwork. **El- Awady et al., 2005** stated that the hydraulic and engineering factors affecting the design of a Self-Compensating Gated Outlet (SCGO) found that the Average discharges from 10.75 to 21.7 L/min were obtained at pressure range of (2 – 9 kPa) coefficients of variation of less than 0.9 %, and head exponent close to zero. Mathematical model & dimensional analysis approach could be used to predict the designed gate outlet discharge with correlation range of 96- 99% between measured and calculated data.

The main objectives of this study:

To evaluate adjusted and self-compensating gated pipe for modified surface irrigation and evaluated the pepper yield response and improve water use efficiency under three water treatments (100, 75 and 50% of ET_C) in old land of Egypt.

MATERIALS AND METHODS

Experimental site:

Field experiments were carried out in the Experimental Farm of Faculty of Agriculture, Ain Shams University, El-Kanater city, Kalubia Governorate, to study the performance analysis of self-compensating gated pipe, traditional gated pipe and effect of irrigation system (drip irrigation ,traditional gated pipe and modified gated pipe) and water requirements on yield and water use efficiency of pepper crop.

Some physical properties of the soil:

Soil particle size distribution was carried out using Pipette method after **(Gee and Bauder, 1986).** Soil bulk density (B.D) was measured after **(Black and Hartage, 1986).** Soil moisture content at field capacity (F.C) and permanent wilting point (P.W.P) were measured according to **(Walter and Gardener, 1986).**

Table 1. Some soil physical properties of the soil:

Soil depth, cm	Particle Size Distribution, %				FC	PWP	AW	BD (g /cm^3)	Texture class
	Coarse Sand	Fine Sand	Silt	Clay		θ_w %			
0-15	0.81	27.8	41.44	29.95	35.45	19.2	16.25	1.25	C.L
15-30	0.7	27.5	41	30.6	35.2	19.44	15.76	1.26	C.L
30-45	0.61	27.8	38.45	33.14	34.7	19.8	14.9	1.28	C.L

FC: Field capacity; PWP: permanent Welting point (Fc and PWP) were determined as percentage in weight;

B.D: Bulk density; AW: Available water; CL: Clay loam

Some chemical properties of soil:

Some chemical properties of the soil were measured such as:

Soil pH and EC were measured in 1:2.5 soils: water suspension and in soil past extract, respectively. Soluble cations and anions were determined by titration methods and flame photometer according to **Jackson (1967).** Some chemical properties of the soil are presented in Table (2).

Table 2. Some chemical analysis of the soil:

Sample depth, cm	pH 1:2.5	ECe dS/m 1:5	Soluble Cations, meq/L				Soluble Anions, meq/L			
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	SO_4^{--}	Cl^{-}
0-15	7.9	0.26	0.41	0.47	0.43	0.19	-	0.64	0.36	0.50
15-30	7.8	0.25	0.46	0.35	0.50	0.17	-	0.76	0.15	0.57
30-45	7.6	0.26	0.55	0.54	0.61	0.2	-	0.78	0.34	0.78

Some chemical properties of irrigation water:

Chemical analyses of irrigation water were carried out by using the standard methods and they are presented in Table (3).

Table 3. Some chemical analysis of irrigation water.

pH	EC dS/m	Soluble Cations, meq/L				Soluble Anions, meq/L			SAR
		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO_3^{-}	SO_4^{--}	Cl^{-}	
7.37	0.85	1.72	0.85	4.78	0.85	2.18	0.14	5.88	4.22

Irrigation systems:

Control head is located at the source of the water supply. It consists of centrifugal pump (80 m^3/h discharge,30 HP and 50 m lift), control value, pressure gauges, P.V.C pipes main line were used to convey the water from the water source to the main control points in the field. Three irrigation systems were selected to irrigate pepper plants. The first is surface built in drip lines system (GR, 4 L/h) with 50cm emitters spacing (SDI) 16mm laterals were used at 60 cm spacing. The second system is modified gated pipe with self- compensating gate outlet (SCGO) Gated pipe body was made of a P.V.C of 63 mm diameter gates diameters is 63 mm distance between gates along line was 60 cm The third system is traditional Gated pipe body was made of a P.V.C of 63 mm diameter gates distance between gates along line was 60 cm.

Components of the designed (SCGO).

The developed self-compensating gate outlet (SCGO) consists of four parts, as shown in Figs. 1 and 2.

Gated outlet body: The gate outlet body was made of a P.V.C pipe of 63 mm out side diameter. The total length of the gate cutlet body is 35cm. The grooved disk rests at 10 cm from the body end. 2) Grooved disk: A P.V.C disk of 58.64 mm diameter of variable thickness was inserted inside the gate outlet body. Four similar radial grooves were formed on the surface of the disk to perform the compensating action together with a rubber membrane. 3) Rubber membrane: of 52.25 mm diameter, 3.38mm thickness and stiffness of 26.27 N/cm. 4) Pin: A P.V.C pin of 4 mm diameter was made to fasten rubber membrane with grooved disk.

Laboratory experiments

Laboratory apparatus was used to measure pressure range from 20-90 cm with an accuracy of 10cm consisting of water manometer and water reservoir with an over flow pipe to establish constant head devise for (SCGO) calibration as shown in fig.3.

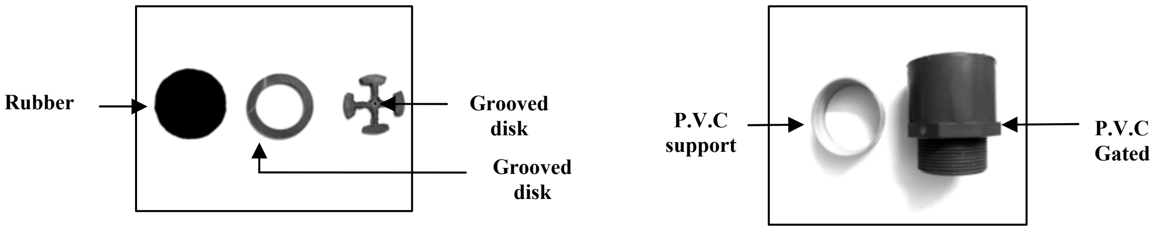

Fig.1 Grooved disk detail

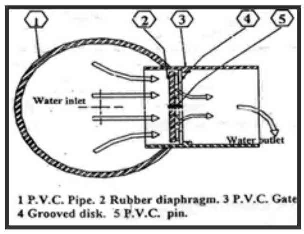

Fig.2 Gate outlet assembly section

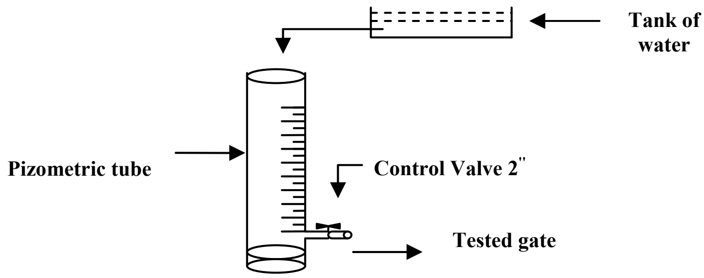

Fig.3 schematic laboratory apparatus constructed for gated orifice test.

Irrigation water requirement calculation:

Irrigation water requirements for pepper were calculated according to the local weather station data at Shalakan affiliated to the Central Laboratory for Agricultural Climate (C. L. A. C), Ministry of Agriculture and Land Reclamation. Irrigation water requirement for pepper crop was calculated from the following equation **(Vermeiren and Jobling, 1980):**

$$IR = (ET_0 \times Kc \times Kr / Ei) + LR$$

Where: IR = Irrigation water requirements.

ET_0 = Reference evapotranspiration mm/day

Kc = Crop coefficient fore pepper crop.

Kr = Reduction factor due to ground cover.

Ei = Irrigation system efficiency.

LR = Leaching requirements.

Water treatments:

Three water application rates were applied for irrigating pepper crop: i.e. 50 %, 75 % and 100 % of water requirements of pepper crop ET_C

Table (4): Average actual application water treatments of tow seasons:

Irrigation system	Water treatments	Actual application m^3/fed
Drip irrigation system	100%	3092
	75%	2319
	50%	1546
Modified gated pipe	100%	4066
	75%	3050
	50%	2033
Traditional gated pipe	100%	4608
	75%	3456
	50%	2304

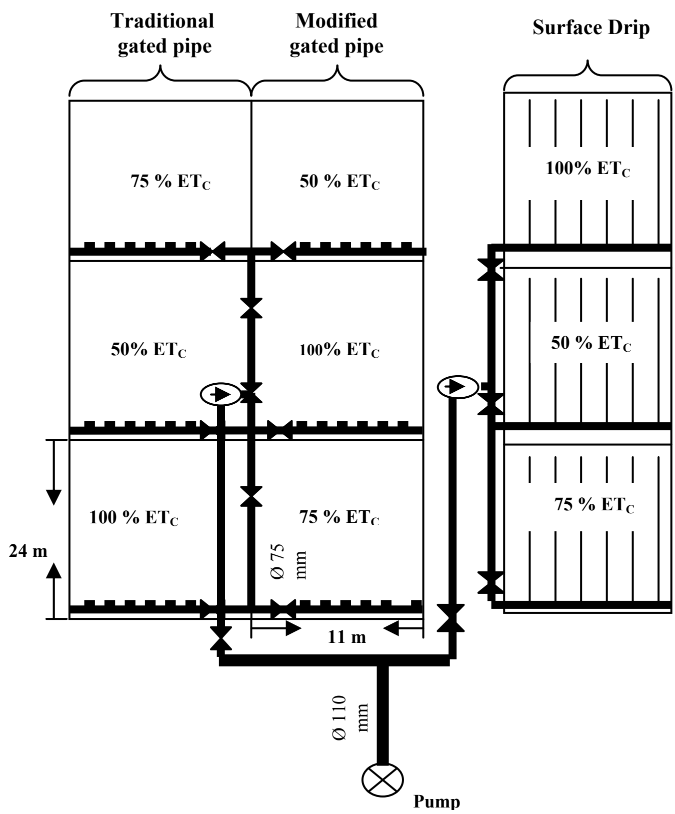

Fig. (4) The layout of the experimental design of irrigation systems

Measurements and Calculations:

Laboratory experiments

Gate discharge

The discharge of gate was determined at different pressure-heads. The following formulas were used to calculate average discharge and discharge range.

$$q_{mean.} = \frac{q_{min.} + q_{max.}}{2} * 100$$

$$q_{rang \pm\%} = \frac{q_{min.\ or\ max} - q_{mean.}}{q_{mean}} * 100$$

$$q_{av} = \sum q / n$$

Where: q: discharge, L/min, n: number of measured points, $q_{min.}$: mean discharge, L/min, $q_{min.}$: minimum discharge, L/min, q_{max}: maximum discharge, L/min, $\sum q$: summation of discharge, L/min, $q_{av.}$: average discharge, L/ min, and $q_{rang \pm}$: discharge variation, %.

Coefficient of variation

Hydraulic design of drip irrigation lateral-line is usually based on a design criterion **(El- Awady et al., 1976 and Wu et al., 1979)** using an emitter flow variation.

$$\mathbf{MCV = (s/q)}$$

"s" is the standard deviation of emitter flow and "q" is the mean emitter flow. The manufacture coefficient of variation (MCV) ranges, in general, from 0.5 to 0.2 for different emitters and lateral-lines **(Solomon, 1979 and Bralts, 1978)**. The AENRI-LOFTI-MSAE Standard (dr\em\test\2002) interpreted MCV as follows "<0.1 → GOOD, 0.1-0.2 → AVERAGE, and > 0.2 → UNSATISFACTORY.

Manufacturing coefficient was calculated for the designed gate outlet to determine its effect on the total variation caused along lateral-line.

Field experiments

1- Hydraulic performance analysis:

a- Measuring discharge along line of traditional and modified of gated pipe under different operating pressure range from (45-90) cm using piezometer tube.

b- Measuring discharge and pressure head of gates outlet along pipe line of traditional and modified gated pipe under constant pressure.

c- The advance time (min), and recession time (min) and of water were recorded at seven points at equal distances along each furrow of traditional and modified gated pipe.

d-Uniformity coefficient was calculated by using the Christiansen uniformity coefficient "CU" **(Perold, 1977 and AENRI-LOFTI-MSAE, 2002)**

$$\mathbf{CU = (1- \ |\delta| \ ) * 100}$$

Where: CU: uniformity coefficient

$|\delta|$:Absolute mean deviation of discharge on along line of pipe

2- Economic yield kg/fed

3-Water use efficiency:

Water use efficiency is an indicator of efficiency of irrigation unit for in creasing crop yield. Water use efficiency of yield was calculated from

$$\text{WUE} \ \ kg/m^3 = \frac{\text{Marketable pepper yield (kg)}}{\text{Irrigation water quality } (m^3)}$$

RESULTS AND DISCCUSSION

Laboratory experiments

Hydraulic characteristics of designed gate:

Fig. 5 shows that self compensating gate outlet discharge slightly increased by increasing pressure in the range (2-9kPa) with gate outlet discharge of 29 lit/min for design geometries that reflect the effect of compensation action caused by grooved disk and rubber diaphragm on discharge regulation.

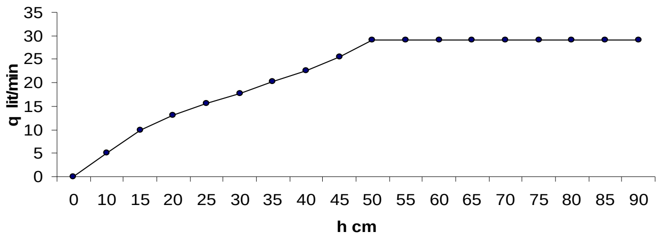

Fig. 5. Effect of pressure on measured discharge for self compensating gate outlet.

Hydraulic characteristic details are summarized in Table 5, showing the manufacture coefficient of variation 0.09 % when gate outlet discharges 29 lit/min. The manufacture variation may be due to the hand making of disk groove. Variations are within "GOOD" category according to AENRI – LOFTI – MSAE standard (2002). Head exponent is 0.1841 showing an acceptable compensating degree for tested gate outlets.

Table (5): The hydraulic characteristic details for developed of modified gated pipe

Gate av. q., lit/min.	Discharge, LPM				*C.V	**δ
	q Min.	q Max.	q mean	±q range %		
29	13	29	21	38.1	0.09	1.923

* Coefficient of variation, ** Standard deviation

Field experiments

1- Hydraulic performance analysis:

Measuring discharge along line under different operating pressure

Fig. 6 and 7 show the effect of different operating pressure head on discharge from each outlet along line of traditional and modified gated pipe (LPM) (Average discharges modified gated pipe of 15 gates a long line between 1.8 – 2 L / m) at pressure head range of 45-90 cm uniform discharge was obtained at modified gated pipe under pressure range of 45-90 cm.

Measuring discharge and pressure head of gates outlet along pipe line under constant pressure

Fig 8 and 9 show that uniform water flow and uniform pressure head from each outlet is unregulated along line of traditional gated pipe but uniform water flow and uniform pressure head from each outlet is regulated a long line of modified gated pipe

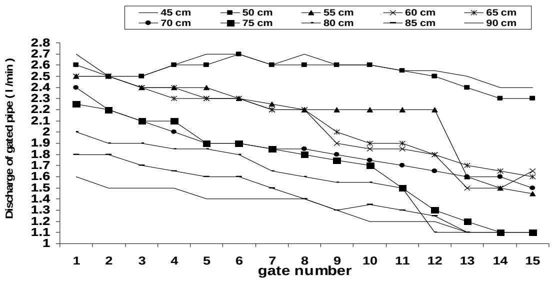

Fig.6 Discharge of traditional gated pipe (LPM) under operating pressure head rang from (45-90) cm.

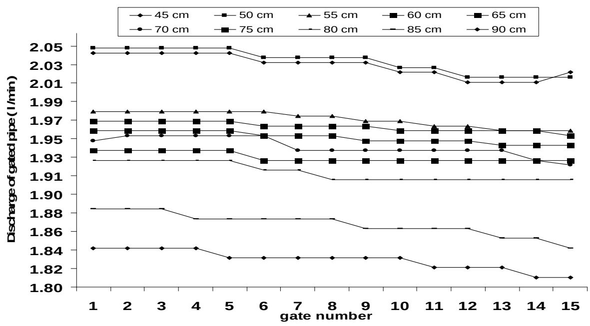

Fig. 7 Discharge of modified gated pipe (LPM) under operating pressure head rang from (45-90 cm).

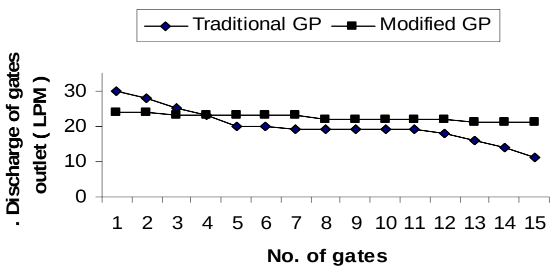

Fig.8. Discharge of gates outlet (LPM) a long pipe line of traditional and modified gated pipe.

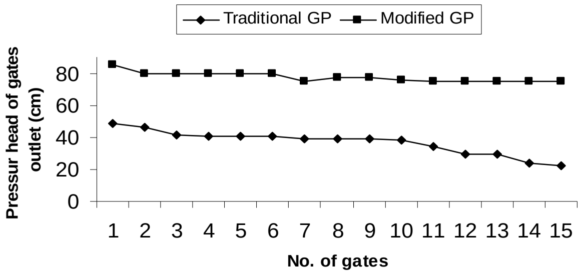

Fig. 9. Pressure head (cm) of gates outlet a long pipe line of traditional and modified gated pipe.

Data presented in Tables 6 and 7 show that advance time (min) of water along each furrow of traditional and modified gated pipe along of pipe. In traditional GP advance time increased from (0.5, 1.1, 2.1, 3.2, 4.3 and 5.4 min) at the first furrow to (1.4, 3.2, 4.8, 8.7, 11.8 and 14.6 min) in the end furrow at distance in meter (4, 8, 12, 16, 20, 24 m), respectively. On the other hand, there are regular advance times approximately in modified GP along furrows (0.6, 1.5, 2.6, 4, 5.4 and 6.7 min) at the first furrow and (0.7, 1.7, 3, 4.5, 6.2 and 7.7 min) in the end furrow at distance in meter (4, 8, 12, 16, 20, 24 m), respectively. This may be due to uniform of discharge and pressure head along pipe line, are shown Figures 8 and 9. The same trend of recession time (min) in traditional and modified gated pipe at the first furrow and the end furrow at distance in meter (4, 8, 12, 16, 20, 24 m), are shown Tables 8 and 9.

Table (6): Time of advance (min) of water along each furrows of traditional gated pipe along of pipe.

Distance in meter	Time of advance, min														
	No. of furrow														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	1.0	1.1	1.4
8	1.1	1.3	1.4	1.6	1.7	1.7	1.9	1.9	1.9	1.9	1.9	2.0	2.2	2.5	3.2
12	2.1	2.3	2.5	2.8	3.1	3.1	3.3	3.3	3.3	3.3	3.3	3.5	4.0	4.5	5.8
16	3.2	3.4	3.8	4.2	4.7	4.7	5.0	5.0	5.0	5.0	5.0	5.3	6.0	6.8	8.7
20	4.3	4.7	5.2	5.7	6.5	6.5	6.9	6.9	6.9	6.9	6.9	7.2	8.1	9.3	11.8
24	5.4	5.7	6.4	7.0	8.0	8.0	8.5	8.5	8.5	8.5	8.5	8.9	10.1	11.5	14.6

Table (7): Time of advance (min) of water along each furrows of modified gated pipe along of pipe.

Distance in meter	Time of advance, min														
	No. of furrow														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
8	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7
12	2.6	2.6	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0
16	4.0	4.0	4.2	4.2	4.2	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.5	4.5	4.5
20	5.4	5.4	5.7	5.7	5.7	5.7	5.7	5.9	5.9	5.9	5.9	5.9	6.2	6.2	6.2
24	6.7	6.7	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.7	7.7	7.7

Table (8): Time of recession (min) of water along each furrows of traditional gated pipe along of pipe.

Distance in meter	Time of recession, min														
	No. of furrow														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	125	127	127	129	129	129	130	130	130	130	130	130	131	131	131
8	131	132	132	133	135	135	132	132	132	132	132	132	133	133	133
12	133	134	133	134	135	135	134	134	134	134	134	134	135	134	134
16	134	135	135	135	135	135	135	135	135	135	135	135	136	136	137
20	135	135	135	135	135	135	135	135	135	135	135	135	136	137	138
24	135	135	135	135	135	135	135	135	135	135	137	137	138	140	140

Table (9): Time of recession (min) of water along each furrows of modified gated pipe along of pipe.

Distance in meter	Time of recession, min														
	No. of furrow														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	123	123	126	126	126	126	126	129	129	129	129	129	129	129	129
8	130	130	133	133	133	133	133	135	135	135	135	135	135	135	135
12	130	130	133	133	133	133	133	135	135	135	135	135	135	135	135
16	135	135	134	134	134	134	134	135	135	135	135	135	135	135	135
20	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135
24	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135

Uniformity coefficient

Uniformity coefficient of distribution (CUD) along line of traditional and modified gated pipe it was found (82.7 and 96.3 %), respectively revert that increase because modified gated pipe contain self compensating pressure perform increase of uniform discharge of gates outlet along pipe line. The uniformity considered **"GOOD"** values for modern irrigation systems according to **AENRI – LOFTI – MSAE** standard **(2002)**.

Economic yield kg/fed

Concerning combined analysis Average the two growing season of fresh yield/fed data illustrated in Fig. (10) showed that the effect of irrigation systems and water regimes on fresh yield/fed of pepper. Generally the highest value (14319.5 kg/fed) under modified GP irrigation system by irrigated 75% ET_C. The modified GP gave the superior in fresh pepper yield (12303.8, 14319.5 and 10833.2 kg/fed) by irrigated 100%, 75% and 50% ET_C treatments, respectively. Followed by drip irrigation system (12299.1, 11057.5 and 8763 kg/fed) by irrigated 100%, 75% and 50% ET_C treatments respectively. While traditional GP irrigation system came later (9433.7, 8762.9 and 8199.4 kg/fed) by irrigated 100%, 75% and 50% ET_C treatments, respectively. This might concluded that irrigated by 75% ET_C under modified GP irrigation system induced the same effect on yield of pepper crop. **Klar and Jadoski (2004)** found that the drought stress caused significant on production and quality of sweet pepper. **Sezen, et al. (2006)** reported that poly normal relations were found between pepper yield and total water use for each irrigation treatments in both seasons.

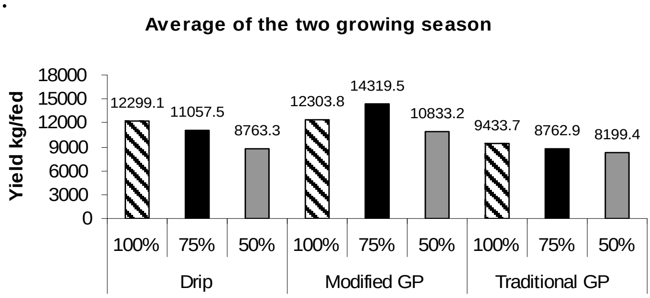

Fig. 10 Effect of irrigation systems and water treatments on Yield

Water use efficiency kg/m3

Concerning combined analysis. Effect of irrigation system and water regimes are presented in Fig. (11). Data in dictated that WUE under the different system and water. Generally the highest value (5.7 kg/m3) under drip irrigation system by irrigated 50% ETC. The drip irrigation gave the superior in WUE (4, 4.8 and 5.7 kg/m3) by irrigated 100%, 75% and 50% ETC treatments, respectively. Followed by modified GP irrigation system (3, 4.7 and 5.3 kg/m3) by irrigated 100%, 75% and 50% ETC treatments, respectively. While traditional GP irrigation system came later (2, 2.5 and 3.6 kg/m3) by irrigated 100%, 75% and 50% ETC treatments, respectively. This might concluded that irrigated by 50% ETC under drip irrigation system induced the same effect on WUE of pepper crop. Data also noticed that the effect induced by water stress under drip irrigation was less than those caused under modified GP irrigation system and traditional GP irrigation system under latter more less than modified GP irrigation system. **Abd-rabbo, et al. (2006)** of treatment under drip irrigation gaves WUE (2.40 kg/m3). **El-Dakrorry (2008)** showed that in the 1st season, surface drip irrigation exhibited the high values of WUE but in the 2nd season, the two drip irrigation was equal. However, the lowest significant vales were by furrow irrigation, whereas gated pipe ranked in between.

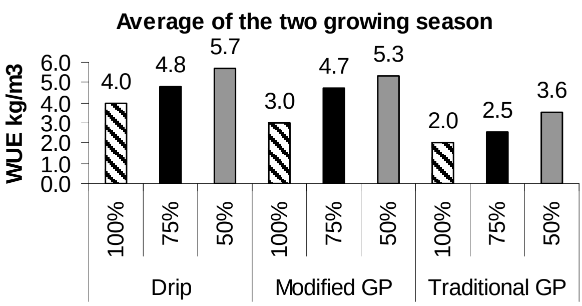

Fig. 11 Effect of irrigation systems and water treatments on Water Use efficiency.

REFERENCES

Abd-rabbo, M. A; Hassanain, M. K. and Medany, W. A:(2006). Improve in WUE for drip irrigation of maize in Egypt. J. Appl. Sci, 21(11B) : 478 – 485.

AENRI-LOFTI-MASE (2002). Standard for irrigation dripper testing, Code No. ir/dr/em/test/2002, The Ag. Eng. Res. Inst. Irrig. Proj. – Misr Soc. Ag. Eng. Standard: 5p.

Black, G. R. and K. Hartage (1986). Bulk density Methods of Soil Analysis. Part1 A gron. 2nd ed. 363-376. ASA and SSSA, Madison, WI (c. ed. Klute, R.).

Bralts, V. (1978). The effect of emitter flow variation on the design of single and dual chamber drip irrigation system. M. Sc. Th., Hawaii U.: 30-45.

El- Awady, M.N.; G.W. Amerhom, and M. S. Zaki (1976). Trickle irrigation trail on pea in conditions typical of Qalubia, Egypt. J. Hort. Sc., 3(1): 99-110.

El- Awady, M. N.; M. T. El- Tanawy: S. S. Hassan and A. O. M. El-Ashhhab (2004). Water- flow uniformity through irrigation gated – pipes. http//www.yahoo.com.

El- Awady, M. N.; A. M. El- Lithy and M. A. Osama (2005). Design and testing of self- compensating outlet for irrigation gated pipe. MISR J. Ag. Eng., 22(3) 775-791.

El-Dakroury, M.A. (2008). Influence of different irrigation systems and treatments on productivity and fruit quality of some bean varieties. M.Sc. Thesis, Faculty of Agriculture Ain Shams University. Cairo, Egypt.

El-Gindy, A.M.; E.A. El-Sahar and A.A. Abdel-Aziz (2000). Physical and mechanical properties of mango fruits under different irrigation systems. Annals-of-Agricultural-Science- Cairo 1: 71-91.

El-Sayed,-G-H (1998). Hydraulic studies for gated pipes distribution system. Egyptian-Journal-of-Agricultural-Research. 1998; 76(1): 387-403

Gee, G. W. and J. W. Bauder (1986). Particle size analyses. Methods of Soil Analysis. Part 1 Agron. 2nd ed. 383-412 ASA and SSSA, Madison, WI (c. ed. Klte, R.)

Gencoglan, C; I.E. Akinci; S.Akinci; S.Gencoglan and K.Ucan (2005). Effect of different irrigation methods on yield of red hot pepper and plant mortality caused by Phytophthora capsiciLeon. Journal-of-Environmental-Biology; 26(4): 741-746

Jackson, M. L. (1967). Soil chemical Analysis, Prentice Hall, Inc.,Englewood Cliffs, USA, 54-56.

Klute, A. and C. Dirksen (1986). Hydraulic conductivity and diffusivity. Laboratory methods. P687-734 Methods of soil analysis. Part 1. Agronomy 2nd edition. ASA and SSSA, Madison, WI. In A. Klute. led)

Osman, H.E (2000). Gated pipes techniques for improved surface irrigation. Annals of Agricultural Science Cairo 1: 145-155.

Osman, H.,(2003). Improved-irrigation – technologies - and- methods: Research, development and testing Proceedings ICID-International-workshop,-Montpellier,France,-14-19-September;1-17

Perold, P. K. (1977). Design of irrigation pipe laterals with multiple outlets, ASCE, 103 (Ir2): 179 – 195.

Sezen, S.M; A.Xazar; and S.Eker, (2006). Effect of drip irrigation regimes on yield and quality of field grown bell pepper. Agric.Water Manag, 81:115-131.

Solomon, K. (1979). Manufacturing variation of trickle emitters, Trans. of the ASAE. 22 (5): 1034 – 1038.

Vermeiren, I. and G. A. Jobling (1980). Localized irrigation: design installation, operation, and evaluation. Irrigation and Drainage paper No. 36. FAO Rome. 203 pages.

Walter, H; and Gardener. (1986). Water content. Methods of Soil Analysis. Part 1 Agron. 2nd ed. 493-544 ASA and SSSA, Madison, WI (C. F. Klute, R).

Wu, I. P., T. A.Howell, and E. A. Hilar (1979). Hydraulic design of drip irrigation systems, Tech. Bull. No. 105, Westren Reg. Res. Proj. W – 128 Report, Hawaii Ag. Exp. St., Hawaii U.: 80 pp.

الملخص العربي

تحليل أداء بوابات ذاتية تنظيم الضغط لتحسين كفاءة الري السطحي

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أجريت الدراسة بمحطة التجارب والبحوث الزراعية التابعة لكلية الزراعة- جامعة عين شمس- محافظة القليوبية في موسمي 2006 , 2007 لدراسة أداء بوابات ذاتية تنظيم الضغط لتحسين كفاءة استخدام مياه الري وتقدير الانتاجية وكفاءة استعمال الماء لمحصول الفلفل تحت نظام الري بالتنقيط والري السطحي بلأنابيب المبوبة التقليدي والمعدل باستخدام بوابة ذاتية التنظيم للضغط تحت معاملات مياه 100%, 75% , 50% من الاستهلاك المائي لنبات الفلفل في الاراضي القديمة.

وتتلخص النتائج فيما يلي:

في تجربة المعمل تم الحصول علىمتوسط تصرف 29 لتر/ د في مدى ضغط 0.02 - 0.09 جوي (ضاغط 20 -90 سم) وكان معامل الاختلاف لانتظامية التصرف 0.9% . تم الحصول على انتظامية في التصرف من البوابات على طول خط الري لنظام الانابيب المبوبة المعدل في مدى ضاغط 45-90 سم بالمقارنة بنظام الري التقليدي وهو مماثل لنتائج تجربة المعمل. تم الحصول على انتظامية للتصرف والضاغط سم من البوابات على طول خط الري لنظام الانابيب المبوبة المعدل تحت ضغط ثابت.تم الحصول على انتظامية في زمن تقدم المياه لنظام الري بالانابيب المعدل في اول الخطوط (0.6, 1.5, 2.6, 4, 5.4, 6.7دقيقة) وفي الخط الاخير (0.7, 1.7, 3, 4.5, 6.2, 7.7 دقيقة) على مسافات مختلفة على طول الخط (4, 8, 12, 16, 20, 24 متر) على التوالي وبنفس المعدل تم الحصول على انتظامية في زمن الانحسار. تم حساب معامل انتظامية التصرف لنظامي الانابيب المبوبة التقليدي والمعدل وكان 82.7% و96.3% على التوالي. سجل اعلى انتاجية لمحصول الفلفل (14319.5كجم / فدان) تحت نظام الري بالانابيب المبوبة المعدل و تحت معاملة مياة 75% من الاستهلاك المائي. كان افضل كفاءة استخدام للمياه تحت نظام الري بالتنقيط تحت معاملة مياة 50% من الاستهلاك المائي لنبات الفلفل (5.7كجم / م^3)

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