SURGE IRRIGATION OF MAIZE UNDER HEAVY CLAY SOIL CONDITIONS AT KAFR EL-SHEIKH GOVERNORATE, EGYPT

Eid, S.M.; M.M. Shahin; N.G. Ainer
Soil, Water and Environment Res. Inst., Agric. Res. Center

ABSTRACT

Field experiments were carried out during 2001 and 2002 summer season at Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt, to improve the furrow irrigation system for better efficiency and, water saving by trying to use the relatively new surface irrigation technique (surge flow irrigation), and compare it with the conventional continuous furrow irrigation in clay soil at Kafr El-Sheikh, Egypt. The experiment was arranged in split plot design with three replicates. The main plots were assigned to furrow length (60 m, 80 m and 100 m), while the subplot treatments were the continuous flow irrigation and three cycle ratios of surge flow irrigation. These treatments were continuous (A). 10 min. on and 10 min. off (B). 10 min on and 15 min off (C), 10 min. on and 20 min off (D). The data obtained showed that, all tested cycle ratios of surge flow irrigation gave lower water advance times, lower amounts of applied water, higher water application efficiency and , higher field water use efficiency, than that continuous flow irrigation. Advance in flow times were reduced in the case of surge flow to 29.7% of the time required for continuous flow. Amounts for applied water were reduced using surge flow irrigation by 27.6%, 31% and 30.6% for cycle ratio 10 on and 20 off, under furrow length 60 m, 80 m and 100 m, respectively. The average values of water application efficiency (WAE) varied from 66.9 to 81.1, 67.4 to 82.6 and from 63.6 to 78.0% for surge flow irrigation, under furrow length 60 m, 80 m and 100 m, respectively. The corresponding values for continuos flow irrigation were, 61.4%, 59.9% and 58.9 under furrow length 60 m, 80 m and 100 m respectively. The average values of water utilization efficiency, for continuous flow irrigation were 1.0, 0.95 and 0.85 kg/m^3. The corresponding values for surge flow treatments varied from 1.03 to 1.30, 1.22 to 1.44 and 1.10 to 1.31 kg/m^3 under 60 m, 80 m, and 100 m, furrow length respectively. For all the studied parameters the

surge flow irrigation with cycle ratio of 0.33 (10 min. on and 20 min off, and furrow length of 80 m, gave the best results.

INTRODUCTION

A primary aim for good irrigation management is to minimize deep percolation of water (infiltration exceeding the irrigation requirements). Deep percolation losses depend directly on irrigation system performance, which in turn, depends mainly on how evenly water infiltrates across the field. Eid *et al.* (1999) showed that surge flow system seemed to be better than continuous irrigation, because it caused less run off, less deep percolation, less opportunity for loading of nutrients chemical minerals in the ground. Mattar (2001) studied the effect of surge furrow irrigation, compared with continuous irrigation on water management at different ploughing methods, he showed that, surge flow treatments required less time for completion the advance phase than with those continuous flow treatments at different ploughing treatments Varlev *et al.* (1995) found that surge irrigation required 20.25% less water than continuous irrigation; whereas, deep percolation decreased from 12-15% to 6-8%, while run off losses reduced from 25-30% to 10-12% by using surge irrigation. Osman *et al.* (1996) stated that surge flow irrigation gave better results; whereas, water advance time and amount of water applied were less than those of continuous one. Surface flooding irrigation by furrows is the most widely used irrigation method in clay soils at Kafr El-Sheikh governorate, Egypt. Many researchers have been carried out to improve the efficiency of surface irrigation. Surge irrigation is used to allow further advance of water to reduce water losses and increasing water use efficiency.

Yonts *et al.* (1991) mentioned that surge irrigation reduced advance inflow time with an average of 20%, compared to continuous irrigation. The aim of this present study is to improve the furrow irrigation system using the surge flow irrigation, for maize cultivated in heavy clay soil, in order to save water and to increase water application and utilization efficiency.

MATERIALS AND METHODS

The current study was carried out at Sakha Agricultural Research Station Farm in Kafr El-Sheikh Governorate, during the two successive seasons 2001 and 2002. Soil physical characteristics, determined according to Klute (1982), are presented in Table (1). Maize crop was sown on July 1 and 3 and was harvested on November 3 and 6 in the 2001 and 2002 seasons, respectively. The experiment was arranged in split plot design with three replicates. The main plot represented furrow length of 60, 80 and 100 m, respectively. While the subplot treatments represented surge irrigation with different cycle ratios, on and off as follows: (A) a continuous flow, (B) Surge irrigation ratio of 0.50 (10 min. on and 10 min. off) (C) Surge irrigation ratio of 0.40 (10 min. on and 15 min. off) (D) Surge irrigation ratio of 0.33 (10 min. on and 20 min. off). Width of each plot was 2.4 m. wooden markeds were placed at regular intervals 10 m each, to serve as station along the furrow and used during measure of water advance. The irrigation intervals duration was fifteen days after the first, planting and first (El-Mohayaa). Irrigation water was applied to furrow of each irrigation treatment, through a plastic pipe of 10 cm inner diameter, and 80 cm length, submerged in the irrigation channell used to apply irrigation water to each treatment. One spile per plot was used to convey water for each treatment. The temporary dam was used to keep the water level constant, which measured several times during irrigation. The discharge to all treatments was 5.345. All cultural practices were the same as recommended for the area except the treatments under study.

Table (1): Some physical properties of experimental site.

Soil depth	Particle size distribution %			Texture	F.C. %	P.W.P. %	Available water %	Bulk density g/cm^3
	Sand	Silt	Clay					
0-> 15	15.08	18.95	65.97	Clay	47.50	25.4	22.1	1.10
15->30	19.00	14.70	66.30	Clay	44.30	21.88	48.42	1.17
30->45	16.50	17.06	66.24	Clay	39.40	21.19	18.21	1.25
45-60	12.0	15.89	67.17	Clay	38.30	20.81	17.49	1.27

Soil water relations:

1. The advance time:

The advance time of water flow for each treatment was recorded, when the water front was reached at station along the furrow. The number of surges were recorded when the irrigation water reached about 95% of the furrow length.

2. Applied water (Wa):

The quantity of applied irrigation water was measured using the submerged orifice formula, according Israelson and Hansen (1962).

$$Q = 0.0226\, D^2\, h^{1/2}$$

Where:

Q = Discharge of irrigation water (L/sec).
D = Inside diameter of the pipe (cm).
h = Average effective head (head causing flow).

3. Soil moisture depletion (SMD):

Soil moisture content was determined gravemetrically as an average of three sub-samples, at four depths (0-15, 15-30, 30-45 and 45-60 cm, just before and two days after each irrigation, as well as. just before harvest time, for all treatments, to determine soil moisture depletion (SMD) according to the following equation:

$$SMD = \frac{D_2 - D_1}{100} \times D \times Bd$$

Where:

SMD = Soil moisture depletion in cm
D = Soil depth in cm
Bd = Bulk density gm/cm^3
D_2 = Soil moisture (%), by weight after irrigation,
D_1 = Soil moisture (%) by weight before irrigation.

4. Water application efficiency (WAE):

The ratio of the average depth of irrigation water infiltrated and stored in the root zone, to the average depth of irrigation water applied, was calculated according to Michael (1978) as follows:

$$(WAE) = WS/WF \times 1000$$

Where:

WAE= Water application efficiency, %
WS = Stored water in the root zone.
WF = Water delivered to each treatment

High application efficiencies mean less deep percolation and less tail water.

5. Field water use efficiency (WUE):

Field water use efficiency, as measure to clarify variations in yield due to irrigation water, was calculated according to Michael (1978) as follows:

$$WUE = Y/Wa$$

Where:

WUE = Field water use efficiency (kg/m^3)
Y = Total yield produced kg/fed. and
Wa = Total applied water m^3/fed.

RESULTS AND DISCUSSIONS

Advance time:

Data obtained for the advance rates along the furrow, for the different treatments in each irrigation run, were presented in Table 2. Data revealed that, in general term, the continuous flow treatment, (A) required more time, to complete the advance phase. than the other treatments of surge flow (B, C and D).

The average advance time of water applied to reach the end of the furrow (60 m), were 52.5, 46.1, 43.6 and 38.0 min. for A_1, B_1, C_1 and D_1 treatments, respectively. While, the furrow length (80 m), were 74.8, 61.5, 58.4 and 51.0 min. for A_2, B_2, C_2 and D_2, respectively. The corresponding values of the furrow length (100 m), were 94.8, 84.2, 75.0 and 65.6 min. for A_3, B_3, C_3 and D_3 treatments respectively. These results indicate that surge flow reduced the total irrigation time by, 29.7%, as compared to continuous treatment, in general.

Such faster water advance rate under surge flow irrigation, may be attributed to the following causes, according to Izadi *et al.* (1991).

1. The decrease of furrows roughness, thus. more stable cross-section during infiltration of water between pulses.
2. Redistribution of water during the time that water is turned off. which causes decrease in the hydraulic gradient, in the top soil layer for the next surge.
3. Hysteresis vs. pressure head relationship.
4. Air entry and entrapment occurring between pulses.

Table (2): Irrigation time (min.) and amount of applied irrigation water m^3/fed. for different irrigation treatments.

Season	Irrigation date		(1) 60 m				(2) 80 m				(3) 100 m			
			A	B	C	D	A	B	C	D	A	B	C	D
2001	1/7	AT	59	59	59	59	80	80	80	80	110	160	110	110
		AW	547.5	547.5	547.5	547.5	552.0	552.0	552.0	552.0	616.0	616	616.0	616.0
	16/7	AT	30	28	25	20	60	46	40	33	80	70.0	55	52
		AW	278.4	259.8	232.0	188.6	414	317.4	276.0	227.7	392.0	392.0	3083	319.2
	2/8	AT	60	42	40	35	75	60	55	44	90	75	70	64
		AW	556.6	389.7	371.2	324.8	517.0	414.0	379.5	303.6	504.0	420	392.2	358.4
	18/8	AT	65	55	50	45	80	75	70	60	10	90	83	70
		AW	603.2	510.4	464.2	417.6	552.0	517.5	483.0	414.0	560.0	504.0	464.8	392.0
	5/9	AT	60	52	50	45	75	65	60	50	105	85	80	65
		AW	550.0	482.6	464.0	417.6	517.0	448.5	414.0	345.0	560.0	476.0	448.0	384
	20/9	AT	50	45	40	35	71.0	60	55	45	95	80	70	63
		AW	464.0	417.6	371.2	324.8	4899	414.0	379.5	310.5	504.0	448.8	392.0	352.8
	5/10	AT	40	37	35	30	70.0	55	50	42	85	85	60	45
		AW	371.2	343.4	324.8	278.4	483.0	379.5	345.0	289.8	448	420.0	336	252.0
Average of AT			52.0	45.4	42.7	38.4	73.0	63.0	58.6	50.6	96.4	83.5	75.4	67.0
Total amount of AW			3377.0	2948.4	2774.7	2496.3	3528	3042.9	2829.9	2442.6	3780	3276.0	2961.0	2626.0

AT = Advance time
AW = Applied water

Table (2): Continued.

Season	Irrigation date		(1) 60 m				(2) 80 m				(3) 100 m			
			A	B	C	D	A	B	C	D	A	B	C	D
2002	3/7	AT	60	60	60	60	85	85	85	85	105	105	105	105
		AW	556.8	556.8	556.8	556.8	586.5	586.5	586.5	556.5	588.0	588.0	588.0	588.0
	18/7	AT	40	35.0	35.0	20	65	40	35	30	77.5	60	50	45
		AW	371.2	324.8	324.8	185.6	448.5	276.0	241.5	207.0	434.0	336.0	280	252.0
	4/8	AT	50	40	35	30	75	60	55	50	90	80	75	65
		AW	464.0	371.2	324.8	278.4	517.5	414.0	379.5	245.0	532.0	448.0	420.0	364.0
	19/8	AT	65.0	45	40	35	80.0	70	65	60	100	95	82	70
		AW	603.2	417.6	371.2	324.8	552.0	483	448.5	4514.0	560.0	532.0	459.2	392.0
	5/9	AT	60	55	53.0	45	78.0	65	60	50	95	90	72	65
		AW	556.8	510.4	491.8	417.6	538.2	448.5	414.0	345.0	532.0	532.0	403.2	364
		AT	57	52	47	42	75	60	56	45	95	85	62	55
	20/9	AW	528.0	482.5	436.2	389.7	517.5	414.0	386.4	310.5	532.0	476.2	347.2	308
		AT	40	40	35	31	65	52	52	40	90	80	55	45
	5/10	AW	371.2	371.2	324.8	287.6	448.5	358.8	358.8	276.0	532.0	448.0	308.0	252.0
Average of AT (min)			53.0	46.7	43.6	37.6	74.8	61.7	51.1	51.4	93.1	85.0	71.5	64.3
Total amount of AW (m^3)			3444.0	3040.8	2830.0	2442.3	3612.0	2982.0	2815.2	2484	3654.0	3332.0	2805.6	2528
(Average of two seasons)	AT (min.)		52.5	46.1	43.1	38.0	73.8	61.5	58.4	51.0	94.8	84.2	75.0	65.6
	AW (m^3)		3410.0	2994.6	2802.4	2469.3	3570.0	3012.4	2822.85	2463.3	3717	3304.1	2942.8	2577.0
Saved water			0%	12.1%	17.8%	27.6%	0%	15.6%	20.9%	31%	0%	11.0%	20.8%	30.6%

AT = Advance time (min.) AW = Applied water (m^3)

5. Surface sealing and consolidation of the soil matrix near the soil surface, which decrease the hydraulic conductivity of the top soil layer.
6. Changes in the hydraulic properties of the soil profile between pulses.

The best treatment was that of 0.33 cycle ratio (10 min. on and 20 min. off) had the lowest advance time of 38.0, 51.0 and 65.6 min. for furrow length of 60, 80 and 100 m, respectively. This means that surge flow cycle of 10 min. on and 20 min. off under the condition of the present study, reduced the irrigation time by about 27.6%, 30.8% and 30.8% compared to the continuous irrigation for 60, 80 and 100 m furrow length, respectively. Generally, using the same on times with different off times (different cycle ratios), revealed that increasing the off time resulted in greater water advance, and reduced total irrigation time. On the other hand, increasing furrow length tended to increase the total irrigation water for continuous, and increase water losses due to deep percolation.

As for furrow length, the amount of water decreased by increasing furrow length from 60 to 100 under surge irrigation, because the number of pulses increased by increasing furrow length and improved irrigation method specification. The same trend of advance time were obtained by Ghalleb, 1987 and Osman *et al.*, 1996.

2. Applied irrigation water (Wa):

Number of irrigations during the whole season were seven, including planting and the first irrigations, as shown in Table (2). all tested cycle ratios of surge treatments used less amount of water than that in continuous one. Results indicated that surge irrigation saved about 27.6%, 31.3% and 30.6%, for cycle ratio 10 on and 20 off, under furrow length 60, 80 and 100 m, respectively. Such results indicate that surge flow irrigation used less amount of water than continuous one. The trend of the abovementioned results are in accordance with those obtained by Ghalleb (1987), Eid *et al.* (1999), Eid (1998). On the other hand, increasing furrow length tended to increase the amount of water/fed. for continuous flow and to increase water losses due to deep percolation. While, the ratio of application water decreased by increasing furrow length, from 60 to

80 m; under surge irrigation. The late of irrigation water increased by increasing furrow length over 80 m, since number of pulses increased by increasing furrow length, improving irrigation method specification. Also, increasing furrow length more than 80 m tended to increase the lateral movement.

Soil moisture depletion:

Values of soil moisture depletion, for the 60 cm depth, as determined by monitoring soil moisture depletion, gravemetrically, for both sites are shown in Table (3). Results indicated that SMD values are higher for continuous irrigation than surge irrigation treatments. The surge treatment (D) recorded the lowest values of total soil moisture depletion 47.3, 46.5 and 45.9 for D_1, D_2 and D_3, while the continuous treatment had the highest values 48.7, 49.5 and 51.2 for A_1, A_2 and A_3, respectively. This might be attributed to the increase of evaporation at high moisture content in continuous treatment (A_1, A_2 and A_3).

Water application efficiency (WAE):

Water application efficiency (WAE) is one of the most important criteria that used to describe field irrigation efficiency. High water application efficiency means, less deep percolation below the crop root zone, and less tail water of furrow Samani *et al.* (1985).

The overall average of WAE values, of continuous irrigation were, 60.0 during the two growing seasons, while, the corresponding values of surge flow irrigation treatments, varied from 65.9 to 80.5% in the average.

The averages of WAE values for continuous irrigation 61.4, 59.9 and 58.9 for 60m, 80 m and 100 m furrow length respectively. The corresponding values for surge flow irrigation treatments were 81.1, 82.6 and 78.0% for 60 m, 80 m and 100 m furrow length. These results indicate that WAE under surge flow irrigation exceed the continuous flow irrigation; whereas, surge irrigation with about 19.7, 22.7 and 19.1% for 60 m, 80 m and 100 m furrow length, respectively. The high efficiency of surge flow can be attributed to the surface sealing that caused by the intermitted wetting and the surface hydraulic roughness of the wet advance, Guirguis (1988).

Table (3): Soil moisture depletion in cm (SMD), storted water in cm (WS), applied water A.W. in cm and water application efficiency WAE in (%) for different irrigation treatments for maize crop (2001 and 2002).

Furrow length	Irrig. treat.	2001				2002				Average of two seasons		
		SMD	W.S	A.W cm	WAE %	SMD	W.S	A.W cm	WAE %	SMD	A.W	WAE
(1) 60 m	A	48.3	50.1	80.4	62.2	49.0	49.8	82.0	60.7	48.7	81.2	61.4
	B	45.6	47.3	70.2	67.3	47.6	48.2	72.4	66.5	46.6	71.3	66.9
	C	46.2	48.4	66.0	73.3	48.5	49.3	67.4	73.1	47.3	66.7	73.2
	D	47.52	48.3	59.42	81.3	47.1	47.2	58.15	81.2	47.3	58.7	81.1
(2) 80 m	A	84.0	49.3	84.0	58.6	51.0	52.8	86.0	61.3	49.5	85.0	59.9
	B	72.4	46.8	72.4	64.6	49.1	49.9	71.0	70.2	47.5	71.7	67.4
	C	67.4	47.0	67.4	69.7	49.7	50.3	67.0	75.1	47.3	67.2	72.4
	D	58.1	48.9	58.1	80.7	49.0	50.0	59.1	84.6	46.5	57.1	82.6
(3) 100 m	A	50.4	52.0	90.0	57.8	52.0	53.0	87.0	60.1	51.2	88.5	58.9
	B	48.0	49.2	78.0	63.0	50.5	51.0	79.3	64.3	49.2	78.6	63.6
	C	46.0	47.3	70.5	67.1	50.1	50.6	60.8	83.2	47.05	68.6	75.2
	D	45.0	46.2	62.52	73.0	46.9	50.0	60.2	83.0	45.9	61.2	78.0

The highest value of water application efficiency was 82.6% for surge irrig. of 10 min-20 min off and 80 m furrow length, meanwhile, the worst value was 58.9% for continuous irrigation method, and 100 m furrow length. WAE increased with the decrease of the cycle ratio (i.e. increase of off time). The best treatment was that of 0.33 cycle ratio 10 m in on and 20 min. off. Goldhamer *et al.* (1987) showed that the application efficiency was higher for surge flow than continuous flow.

Field water use efficiency (WUE):

Filed water use efficiency is one of the most important water economy criteria. It is the ratio of crop yield to the total applied amount of water.

Data presented in Table (4) showed that surge flow treatments, recorded the highest values of WUE, compared with continuous flow, either under 60, 80 and 100 m furrow length. The overall average of WUE values, for continuous flow were 1.0, 0.95 and 0.85 kg/m^3 for 60, 80 and 100 m furrow length, respectively. The best surge flow treatment was 10 m. on and 20 min. off under 80 m furrow length, having the highest WUE value of 1.44. Explanation of such results, is that surge flow irrigation leads to higher water distribution uniformity, less water losses by deep percolation, and less amount of applied water during the irrigation. These results are similar to those obtained by Osman 1991, Ghalleb, 1987, Eid, 1998 and Osman, 1999.

Table (4): Field water use efficiency of maize in kg/m^3 under different irrigation treatments.

	Cycle ratio		Season 2001			Season 2002			Average of two seasons
	On	Off	Yield kg/fed.	WA m^3/fed.	WUE kgm	Yield kg/fed.	WA m^3/fed.	WUE kgm	
60	Cont.		3410.5	3376.8	1.01	3409.6	3444.0	0.99	1.00
	10	10	3066.3	2948.4	1.04	3101.6	3040.8	1.02	1.03
	10	15	3603.6	2772.0	1.30	3113.8	2830.8	1.10	1.20
	10	20	3369.1	2495.6	1.35	3052.8	2442.3	1.25	1.30
80	Cont.		3528.0	3528.0	1.00	3250.8	3612	0.90	0.95
	10	10	3770.5	3040.8	1.24	3578.9	2982	1.20	1.22
	10	15	3906.5	2830.8	1.38	3658.2	2814	1.30	1.34
	10	20	3611.5	2440.2	1.48	3475.0	2482.2	1.40	1.44
100	Cont.		3024.0	3780.0	0.80	3288.6	3654	0.90	0.85
	10	10	3603.6	3276.0	1.10	3663.6	3330.6	1.10	1.10
	10	15	3553.2	3961.0	1.20	3478.9	2805.6	1.24	1.22
	10	20	3466.1	2625.8	1.32	3292.4	2532.6	1.30	1.31

REFERENCES

Eid, S.M. (1998). Surge flow irrigation for corn and wheat under different land levelling practices in heavy clay soils. Ph.D. Thesis. Soil Sci. Dept. Fac. of Agric. Kafr El-Sheikh, Tanta University.

Eid, S.M.; M.M. Ibrahim; S.A. Gaheen; S.M. Ibrahim and S.A. Abd El-Hafez (1999). Evaluation of surge flow irrigation system in clay soil under different land levelling practices. Soil, Water and Environment Res. Inst. Agric. Res. Center. Third Conf. On Farm Irrigation and Agroclimatology. 25-27 January, 1990, Dokki, Egypt.

Ghalleb, A.A. (1987). Evaluation of surge irrigation for different crops. Ph.D. Thesis. Fac. Agric. Alex Univ., Egypt, pp. 189.

Goldhamer, D.A.; M.H. Alemi and R.C. Phene (1987). Surge vs. continuous flow irrigation. California-Agriculture. 41: 9-10, 29-32.

Guirguis, A.El.K. (1988). Evaluation studies of surge flow furrow irrigation. M.Sc. Thesis, Fac. Agric. Alex. Univ., Egypt.

Israelson, O.W. and V.E. Hansen (1962). Flow of water into and through soils. Irrigation principles and practices. 3rd Edition, John Wiley and Sons, Inc., NEW York, N.Y., USA.

Izadi, B.; D. Studer and I.R. McCann (1991). Maximizing set-wide furrow irrigation application efficiency under full irrigation strategy. ASAE, 34, 5, 2006-2014.

Klute, A. (1982). Methods of soil analysis part 1, "Physical and mineralogical methods", with, Madison, U.S.A.

Mattar, M.A. (2001). Relationship between ploughing methods and surge irrigation and its effect on water rationalization. M.Sc. Thesis, Fac. of Ag. Kafr El-Sheikh, Tanta Univ., Egypt.

Michael, A.M. (1978). Irrigation Theory and Practice. Vikas Publishing House PVT. Ltd.

Osman, A.M. (1991). Surge flow irrigation for corn and faba bean in clay soil Ph.D. Thesis. Soil Sci. Dept. Fac. of Agric. Alex Univ., Egypt.

Osman, A.M.; M.M. Attia and M.A. Sayed (1999). Surge flow irrigation for corn under different irrigation intervals in calcareous soil of West Nubaria Region. Soil, Water and Environment Res. Inst. Agric. Res. Center. Third Conf. On Farm Irrigation and Agroclimatology. 25-27 January, 1990, Dokki, Egypt.

Osman, A.M.; M.M. Attia; H . El-Zaher and M.A. Sayed (1996). Surge flow furrow irrigation in calcareous soil. I. Furrow advance time function and applied water. J. Agric. Sci. Mansoura Univ., Egypt. 21(10): 3671-3678.

Samani, A.Z.; W.R. Walker and L.S. Willardson (1985). Infiltration under surge flow irrigation. Trans. ASAE 28(5): 1539-1542 p.

Varlev, I.; Z. Popova; I. Gospodinov and N.X. Tsiourtis (1995). Furrow irrigation by surges as water saving technology. Proceedings of the EWRA 95 Symposium Nicosia. Cyprus, 14-18 March. 277-280.

Yonts. C.D.; D.E. Senhauer and J.E. Cahoon (1991). Fundamentals of surge irrigation Nebraska extension, University of Nebraska, Neb Guide, Ge 91-1018.

الرى النبضى للذره تحت ظروف الأراضى الطينية الثقيلة بمحافظة كفرالشيخ ــ بجمهورية مصر العربية

د.صبحى محمد عيد ، د.مجدى محمد شاهين ، د. نصر جميل عينر
معهد بحوث الأراضى والمياه والبيئة ــ مركز البحوث الزراعية

أجريت تجربتان حقليتان فى مزرعة محطة البحوث الزراعية بسخا بمحافظة كفرالشيخ خلال موسمى ٢٠٠١ ، ٢٠٠٢م وذلك لتحسين نظام الرى فى خطوط بكفاءة احسن وتوفير للمياه باستخدام نظام الرى النبضى ومقارنة ذلك بالرى المستمر وكانت المعاملات الرئيسية كالآتى:

طول الخط:

١- طول الخط ٦٠م.
٢- طول الخط ٨٠م.
٣- طول الخط ١٠٠م.

والمعاملات تحت رئيسه:

أ- الرى المستمر.
ب- الرى النبضى (إضافة المياه ١٠ دقائق فتح وغلق ١٠ دقائق).
جـ- الرى النبضى (إضافة المياه ١٠ دقائق فتح وغلق ١٥ دقيقة).
د- الرى النبضى (إضافة المياه ١٠ دقائق فتح وغلق ٢٠ دقيقة).

والنتائج المتحصل عليها أوضحت أن جميع دورات الرى النبضى كانت أقل فى زمن تقدم المياه وأقل فى كمية المياه المضافة وأعلى فى كفاءة الرى المضاف وأعلى فى الكفاءة الاستعمالية لوحدة المياه المقارنة بالرى المستمر.

ويمكن تلخيص النتائج فى الآتى:

١- زمن تقدم جبهة المياه إلى نهاية الخط كان أقل بنسبة ٢٩,٧% من الزمن اللازم للرى المستمر.
٢- كمية المياه المضافة إنخفضت باستخدام الرى النبضى بنسبة ٢٧,٦% ، ٣١,٠% ، ٣٠,٦% وذلك للمعاملة (إضافة المياه ١٠ دقائق وبغلق ٢٠ دقيقة ، وذلك لطول الخط ٦٠ ، ٨٠ ، ١٠٠م على الترتيب.

٣- القيم المتوسطة لكفاءة إضافة مياه الري في الري النبضي تراوحت من ٦٦,٩% إلى ٨١,١% ومن ٦٧,٤% الى ٨٢,٦% ، ومن ٦٣,٦% إلى ٧٨,٠% وذلك لطول الخط ٦٠ ، ٨٠ ، ١٠٠م على الترتيب. بينما كانت في الري المستمر ٦١,٤% ، ٥٩,٩% ، ٥٨,٩% لنفس أطوال الخط.

٤- الكفاءة الاستعمالية لوحدة المياه تراوحت بين ١,٠ ، ٠,٩٥ ، ٠,٨٥ تحت الري المستمر للأطوال ٦٠ ، ٨٠ ، ١٠٠م على الترتيب. بينما تراوحت من ١,٠٣كجم/م^3 إلى ١,٣كجم/م^3 ومن ١,٢٢كجم/م^3 ، إلى ١,٤٤كجم/م^3 من ١.١٠كجم/م^3 إلى ١,٣١كجم/م^3 للأطوال الخط ٦٠ ، ٨٠ ، ١٠٠م على الترتيب.

يتضح من هذه الدراسة أن أحسن معاملة كانت ٠,٣٣ (١٠ دقائق وفتح و ٢٠ دقيقة غلق) وطول خط ٨٠م أعطت أحسن النتائج. ويمكن التوصية بها لادارة مياه الري للذرة تحت ظروف منطقة الدراسة.