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EFFECT OF LEVELING AND SURGE IRRIGATION ON WATER RATIONALIZATION

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ABSTRACT

Surge irrigation is a new innovation in surface irrigation showed its merits in increasing irrigation efficiency and other performances, especially in furrows. The present study aims to assess the potential of using surge irrigation on borders. Field tests were conducted on borders (9.5m x70m)of heavy clay soil. Two different land treatments (dead and traditional levelling) were examined to compare surge flow of (20 min. on / 30 min. off) with continuous irrigation for assessing their potential in improving irrigation system of Egyptian clover (Giza 6 multi-cut type). Water applied during surge irrigation advanced faster in comparison with continuous irrigation with water saving of 17.66% to 20.62% in surge irrigated plots under the dead and traditional levelling methods. In addition, Higher crop yield was obtained as an another advantage for the surge irrigated plots. Keeping in view different parameters as amount of water, distribution uniformity, application efficiency, deep percolation losses and yield of and Egyptian clover (Giza 6 multi- cut type), the surge mode of irrigation is convincingly better in comparison with the conventional continuous irrigation even under the border irrigation.

INTRODUCTION

One of the disadvantages of surface irrigation is reduction of efficiency which may be rich to 50% due to deep percolations, run off and low distribution uniformity for water and the final result is low production. So the aim of this paper is improving the efficiency of surface irrigation using surge irrigation system with dead and traditional leveling on water rationalization. Bishop et al. (1981) defined that " The intermittent application of irrigation water to furrow or border creating a series of on and off condition of constant or variable time span at the furrow inlet " They defined the cycle time as " the period required for a complete on / off cycle "i,e, the time between the beginning of one surge to the beginning of the next, The cycle time may be of any desired duration and can vary from a few seconds to hours, but present experience indicates a typical cycle time 10 min – 60 min. Also they defined the cycle ratio as "The ratio of the on time to cycle time "With conventional irrigation, no off time, making the cycle ratio equal to on (continuous flow).Reiss,(1984) showed that precision land leveling (controlled laser equipment) has shortened irrigation time and has significantly increased profits for farmers and increased production of wheat. Seif El Yazal et al (1985)found that precision land leveling has increased irrigation efficiency and yield in large basin irrigation for fields of wheat and also found that land leveling with controlled laser equipment resulted in saving irrigation water and increasing crop production for maize. Ismail et al ., (1985) Ghallab (1987) Osman (1991) summarized the potential benefits of using surge rather than continuous irrigation ,as follows: Faster advance ,which results in more

uniform water distribution .The accelerated advance rates and accompanying reductions in water volume necessary for the completion of one irrigation attributed to a reduction in the infiltration rate. less water used or more acres irrigated with the same amount of water. Reduction in the total irrigation times. Increased distribution uniformity, thus greater opportunity for increased yield. More energy efficient and decreased labor for management and possibility. Hassen EL Banna (1987)found that using laser controlled equipment method in land leveling greatly decreased the consumption of water and increased the yield produced per unit area specially under spile method of surface irrigation. Awady et al., (1988) found that the reduction in water volume required during the season for surge irrigation of wheat was 23% less than for the continuous irrigation under the same condition and also studied the effect of surge irrigation on water distribution efficiency and yield water use efficiency. The surge irrigation system increases water distribution efficiency and yield water use efficiency.Zein EL-Abedin (1988) reported that the maximum application efficiency was about 40 % under continuous flow while it reached over 80 % under surge flow. Increase in the application efficiency can be obtained by increasing the field slope and decreasing the field roughness. Zaghloul (1988) carried out field studies on wheat during three growing seasons to compare surge flow border strip irrigation with conventional continuous flow in the clay soil. He added that the grain yield increases with increase of cycle ration slope and inflow rate and decrease by increasing the number of pulses per irrigation. The maximum increase in yield is found for cycle ratio 0.8, these results may be attributed to the higher water distribution efficiency and less water losses by deep percolation Lenka (1991) showed that the border strip method is suitable for irrigation most of the close growing crops. It is chief advantages are: Can be constructed with cheap farm equipment, irrigation labor requirement is greatly reduced, uniform distribution of water use efficiency, and large irrigation streams can be efficiently Morcos et al. (1996) reported that in border irrigation , the surge flow of (5 min on – 5 min off), (10 min on – 10 min off) and (15 min on –15 min off) reported the total net advance time by about 29.6%, 33.3% and 32% compared with the continuous flow. This means that the surge flow reduced 12.78 m3/border, 14.4 m3/border and 13.8 m3/border form_the amount needed for continuous. They also, added that in furrow irrigation, the surge flow of (5 min on – 5 min off), (10 min on – 10 min off) and (15 min on –15 min off) reduced the total net by about 29.4%, 34.2% and 28,6 % compared with continuous flow. This means that the surge flow reduced 2.26 m3/furrow, 2.56 m3/furrow and 2.16 m3/furrow form the amount needed for continuous. Eid (1998) reported that surge flow had the highest water advance rate, either under dead or traditional leveling. Surge flow saved 22% and 18% of the time required for continuous flow to complete the irrigation, under dead and traditional leveling respectively. He also, indicated that surge flow irrigation used less amount of water than in continuous one. It could save water on average for all treatment by about 19.1% and 16 5% of the continuous flow irrigation under dead and traditional leveling respectively. The best treatment (20 min on and off) could save water with an average of 28.2% (959.4

m3/fed) and 23.9% (911.4 m3/fed) of the applied water to corn under dead and traditional leveling respectively. Mater (2001) reported that surge irrigation with 4 surge (6 – 11 -15 – 18) min on and 15 min off increased the value of water application efficiency when compared with continuous flow at the same ploughing methods. Abd El-Hakim (2007) reported that surge treatment occurs series of on and off times help to improve infiltration rate and changes in the hydraulic properties of the soil profile between pluses.

MATERIALS AND METHODS

Material:

The current investigation has been conducted during 2012-2013 seasons at Bahtem -Qaliobya Governorate, Egypt in heavy clay soil, to study the overall impact of land leveling and irrigation systems on water rationalization. Two different types of land leveling (traditional and dead leveling) and two types of irrigation methods (surge irrigation and continuous irrigation) had been investigated in this study. Moisture distribution, yield productivity, available irrigation time and water use efficiency were measured. The water used as irrigation source having EC of 650p.p.m.

Specification of the equipment:

The technical specification of the experimental equipment is summarized as follows:

1-Tractor Kubota M-1oo type made in Japan five cylinder four stork, diesel engine, water cooling hydraulic system, four wheels 93 hp.

2-Tractor Fiat TD-120 type made in Italy six cylinder four stork, diesel engine, water cooling hydraulic system and four wheels 120 hp.

3-Chisel plough with nine mounted shares two meters width, four shares in front and five in rear distance between each two consecutive shares are 25 cm and total mass of the plough is 375kg.

4-Ordinary scraper 10 feet was used for traditional leveling and similar scraper equipped with laser was used for dead leveling.

Methods:

A field area of 114 m x70 m was divided into two main blocks each 57mx70m. Each block consisted of 6 borders of equal sizes(9.5mx70m).The first block was assigned for traditional levelling with two different types of applied water (surge flow of (20 min .on / 30 min. off) and continuous flow irrigation),the second block was assigned for dead levelling with two different types of applied water (surge and continuous irrigation),

Soil type and its characteristics:

Data presented in Table, (1) presents the soil texture and soil properties. Soil water extract sample as described by Black (1965).

Table (1): Soil physical properties of the experimental site before leveling process.

Soil Depth (Cm)	Particle size distribution			Soil Texture	Bulk Density	Field Capacity	Permanent Wilting point	Available Water
	Sand	Silt	Clay		Mg/m³	%	%	%
	%	%	%					
0-20	17.20	27.68	55.12	Clay	1.102	40.80	21.47	19.33
20-40	21.32	18.21	60.47	Clay	1.122	38.44	21.03	17.41
40-60	17.84	21.55	60.61	Clay	1.128	37.11	20.35	16.76
60-80	16.56	26.43	57.01	Clay	1.137	36.36	19.54	16.82

Soil bulk density:

Soil bulk density (Mg/m^3) was determined for different treatments and the obtained values are shown in Table (2). The Soil bulk density was measured with a cylindrical prope ($100cm^3$ content). The soil samples were taken at four depths: 0-20, 20-40, 40-60 and 60-80 cm. The samples from the cylinder prope were dried in a drying chamber at 105ºC for hr. It was computed as follows:

$$Ds = \frac{Dss}{Vt} X100 \quad \text{---------- (1)}$$

Where;

D_s=Soil bulk density, Mg/m^3, and D_{ss} =dry soil weight, Mg.

V_t = Total soil volume, cm^3

Table (2) Soil bulk density (Mg/m^3) as influenced by the leveling process.

Land levelling	Bulk density (Mg/m^3) for different depths (cm)				
	0 - 20	20 – 40	40 – 60	60 – 80	Mean
Traditional	1.16	1.21	1.26	1.31	1.23
Dead	1.25	1.33	1.41	1.52	1.37

In general, the average values of soil bulk density were relatively high under the condition of dead level. This trend may be true due to soil compaction resulted from passing of heavier equipment during the levelling process.

Soil and water parameters:

-Fild water applied (Q) ,m^3/min.

The water applied was measuring by a flow water from measuring of $A90^o$ triangular notch and water surface above $A90^o$ triangular notch. The calculation of water discharge was calculated using the following equation:

$$Q = 2.49H^{5/2} \quad \text{---------- (2)}$$

Where: H= Operation of head, m.

Soil moisture content:

Soil moisture content was measured by the gravimetric methods, Michael (1987). According to this method, soil samples were weighted and dried in an oven at 105^0C for about 24 hours until all the moisture was driven off, and then the samples were weighted again after taken by screw auger.

Soil moisture content by dry weigh and Soil moisture content percentage by volume were calculated from the flowing equations:

$$\text{Soil moisture} = \frac{soil\ wet\ weight - soil\ dry\ weight}{soil\ dry\ weight} * 100 - - - 3 \quad (3)$$

Water use efficiency:

Water use efficiency has been used to describe the relationship between crop production and the total amount of water used. It was determined by applying the following equation (Jensen 1983):

$$WUE = \frac{Y}{Wa} \quad \text{---------- (4)}$$

Where:

WUE = Water use efficiency:

Y = total yield Kg / fed and W_a= total applied water,m^3/fed/season

Water saving:

Water saving was expressed in terms of volume ratio. The ratio of water volume applied during surge irrigation to a border as related to the volume of water applied in the conventional/ continuous method was calculated using the following equation:

$$\text{Water saving (\%)} = (v_c - v_s) / v_c \times 100 \ldots\ldots (5)$$

v_s = water volume in surge irrigation per season

v_c = water volume in continuous irrigation.

RESULTS AND DISCUSSION

Amount of water applied:

The total amounts of water applied to reach the end of border for different studied treatments are given in table (3). The results show that the total applied water was the highest at continuous flow irrigation while the lowest values were obtained for surge flow irrigation. Where the total amount of water added to surge flow treatment were 626.09 m3/fed. and 821.989 m3/fed. for dead and traditional leveling methods respectively. While, the total amount of water added to continuous flow treatment were 788.78 m3/fed. and 998.43 m3/fed. for dead and traditional leveling respectively. This means that, the total amount of water applied by dead and traditional leveling surge flow treatment were 79.37% and 82.32 % of the water applied by continuous flow treatment respectively. These results showed considerable reductions in water applied by using dead and traditional leveling surges treatments. In other words, surge flow technique caused a great reduction in total water volume used compared to the volume used by the continuous flow technique.

Table (3) Effectiveness of irrigation advance using volume ratio.

Land leveling	Irrigation method	Discharge (m^3 /min)	Time (min)	Water volume (m^3)	Volume ratio (v_s / v_c)	Water saving %
dead	Surge	0.751	132	99.132	0.79	20.62
	continuous	0.751	166.3	124.89	-	-
traditional	Surge	0.751	173.3	130.148	0.82	17.66
	continuous	0.751	210.5	158.08	-	-

Water advance

Water advance time in surface irrigation plays an important role in water application and distribution of water in the soil root zone. Whereas, surface irrigation design and management objectives are generally to complete the advance phase of the irrigation as quickly as possible to minimize the run off and deep percolation losses during the intake phase. This leads to improve the border irrigation system for better efficiency and water saving by using the relatively new surface irrigation technique (surge). In addition, the relationship between the advance time and distance from border inlet for surge and continuous irrigation methods defined as follows:

Surge versus continuous flow irrigation advance

Data in fig. (1) showed that, 20.63 % less time is required to complete the advance phase under surge flow compared with continuous flow irrigation on border under dead levelling treatments. This means that, the cumulative advance time required for water to reach the end of the border was 132 minutes with surge irrigation and 166.3 minutes with continuous irrigation under dead levelling process.

Fig. (1):A comparison between surge and continuous flow irrigation advance times under dead leveling process.

On the other hand data in fig. (2) showed that, 17.6 % less time is required to complete the advance phase under surge flow compared with continuous flow irrigation on border under traditional levelling treatments. This means that, a cumulative advance time required for water to reach the end of the border was 173.3 minutes with surge irrigation and 210.5 minutes with continuous irrigation under the traditional levelling process.

Fig. (2):A comparison between surge and continuous flow irrigation advance times under tarditional levelling process

From the previously mentioned results, it can be concluded that the surge irrigation has better performance compared with continuous irrigation system under both dead and traditional levelling in terms of time.

Generally, the continuous flow irrigation required more time to complete the advance phase than the surge flow irrigation under the same leveling conditions.

Effect of land leveling on advance time of water front in surged flow.

Data of cumulative advance time for two different methods of land levelling averaged across the surge irrigation system is given in fig. (3). The results indicated that 23.83 % less time is required to complete the advance phase under dead levelling method compared with traditional levelling on border under surge flow treatment. This means that, the cumulative advance time required for water to reach the end of the border was 173.3 minutes for the traditional levelling and 132 minutes for the dead levelling under surge flow irrigation treatment.

Fig. (3)Effect of land level in advance time of water front in surged flow

On the other hand data in fig. (4) showed that 20.99 % less time is required to complete the advance phase under dead levelling compared with traditional levelling on border under continuous flow treatments .This means that, the cumulative advance time required for water to reach the end of the border was 210.5 minutes for traditional levelling and 166.3 minutes for dead levelling under continuous flow irrigation treatment.

fig. (4)Effect of land level in advance time of water front in continuous

The previously mentioned results indicated that the dead levelling has better performance compared with traditional levelling under surge and continuous flow irrigation in terms of time. However, the traditional levelling required more time to complete the advance phase than the dead leveling under the same irrigation condition.

Moisture distribution:

Soil samples taken from different depths and locations on the length and width of the border to estimate the moisture content before and after irrigation.

From the experimental results and when comparing soil moisture content of surge irrigation_treatment with continuous irrigation treatment before and after irrigation for 48 ,72 and 96 hours under land leveling (dead and traditional leveling),. Figs. (5 to 12). showed that the highest moisture content percentages in different soil profiles after irrigation were obtained in depths from 0 to 20cm from the soil surface under surge irrigation. On the other hand, under continuous irrigation system, the highest moisture content percentages in all treatments were obtained in the depths of 60 to 80 cm from the soil surface as showed from Figs. (5 to 12). The moisture content generally decreased as the soil depth increase. The observed high moisture content in different depths of soil under continuous flow with traditional leveling treatment may be attributed to the increase of total amount of water applied by the continuous flow treatment. Meanwhile, the moisture content is not recorded any difference between the surge flow with dead leveling on the length and width of the border. On the other hand, The moisture content under continuous flow with traditional leveling treatment was higher in same places in the first and end of the border. However, on the middle of the border the moisture content was low. This variation may be attributed to the land leveling process for all treatments.

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The moisture content (for 80 cm depth of soil) was low with surge flow and dead leveling treatment compared with continuous flow with dead leveling. Also, the moisture content was higher under traditional leveling treatments compared with dead leveling treatment under the surge and continuous flow treatments specially for the depths of soil between (60cm and 80 cm). While under surge flow with dead leveling treatments there was more homogeneous distribution of moisture content. In general, the total amount of water applied for all treatments reflected on moisture content which were nearly similar after 48 hours of irrigation. On the other hand after 96 hours of irrigation it was found that the soil moisture content was relatively higher especially under higher depths of soil for continuous flow compared with surge flow.

The observed higher values of moisture content in different depths of soil under continuous flow with traditional levelling treatment may be attributed to the higher amount of water added to the soil during the traditional irrigation and levelling process.

Water saving:

Water saving can be expressed in terms of volume ratio of water applied during surge irrigation on border to the volume of water applied in the conventional/ continuous method. Data in table (3) showed that the values of volume ratio for different dead levelling treatment were always less than one .This ratio attributed to the lower required time to complete the advance phase in surge irrigated borders compared with continuous irrigation. On other words, with decreasing of land levelling (traditional levelling) the volume ratio increased. While, it was increased with increasing land levelling (dead levelling). Data in table (3) showed that there were saving in the applied water under surge irrigation system compared with continuous irrigation system by ratio of 20.62% (162.69 m3) and 17.66 % (176.044m3) under dead and traditional leveling respectively. It is enough to irrigate another area equal to 1091.37 m2 (0.259 fed.) and 899.506 m2 (0.259 fed.) under dead and traditional leveling respectively.

Generally, for all possible combinations of land levels, the volume ration remained less than one This clearly indicates less total water required to complete the advance phase in surged irrigation compared with continuous one. Further, it was revealed that a surge irrigation system coupled with dead levelling resulted in a maximum water saving of 20.63 % among all the other combinations. While, it was 17.67% for traditional levelling.

Yield of crop:

One of the importance in the evaluation of any soil- water –plant system is the yield of crop.

Yield of alfalfa forage green for surge and continuous flow irrigation treatments and different land leveling systems is shown in Table (6).Yields of Egyptian clover (Giza 6 multi- cut type) forage green for surge flow treatments were 9458 and 7311 kg/fed. For dead and traditional leveling, respectively. The corresponding values were 9238 and 7012 kg /fed. For dead and traditional leveling, respectively.

From the previously mentioned results, it can be concluded that the

highest Yield of alfalfa forage green was obtained under surge flow treatments compared with continuous flow treatments. and also for the dead leveling plots compared with traditional leveling.

The highest production in surge flow irrigation may be attributed to increasing soil aeration with relatively fewer amounts of applied irrigation water, especially with the dead leveling. However under continuous flow irrigation the Egyptian clover (Giza 6 multi- cut type) yield may be decrease due to the leaching of nutrients from the soil profile as a result of high amount of drained water .especially with the traditional leveling.

Table (4) Yield and field water use efficiency for surge and continuous flow irrigation under two different land leveling.

Irrigation method	land leveling					
	Dead			Traditional		
	Yield kg/fed.	Applied water m^3/fed.	water use efficiency kg / m^3	Yield kg/fed.	Applied water m^3/fed.	water use efficiency kg / m^3
Surge	9485	626.09	15.1	7311	821.989	8.89
Continuous	9238	788.78	11.71	7012	998.43	7.23

Water use efficiency:

Water use efficiency (WUE) is one the most important criteria, where it is of greater practical importance. Water use efficiency is the ratio of crop yield to the total amount of water. The highest value of water use efficiency means less amount of irrigation water and highler crop yield. Field water use efficiency for different treatments are presented in table (4) The water use efficiency values for surge flow irrigation treatments were 15.1 kg / m^3 and 8.89 kg / m^3 under dead and traditional leveling methods respectively. But in the case of continuous irrigation they were 11.71 kg / m^3 and 7.3 kg / m^3 under dead and traditional leveling respectively.

The above mentioned results showed that surge flow irrigation improved the water use efficiency in comparison with the continuous flow irrigation. Highest value of water use efficiency was obtained when surge flow irrigation treatment applied and dead levelling used. This is may be attributed to more rapid advance rate for the wetting front.

CONCLUSOIN

Surge flow border irrigation is a new irrigation technique for controlling border irrigation. The main purpose of this study was to investigate the effect of Surge flow border irrigation comparing with continuous irrigation on water management and yield of Egyptian clover (Giza 6 multi- cut type)with different land levelling methods(dead and traditional leveling) . According to the obtained results, it may be concluded that:

1- Surge flow method required less time to complete the advance phase than continuous flow method due to infiltration rate reduction which results from the surface sealing and soil consolidation occurred.
2- The surge flow caused reduction in the quasi-steady infiltration rates of the two studied land leveling methods despite shorter opportunity times for the surge treatments.

3-Surge treatments occurs series of on and off times help to improve infiltration rate and changes in the hydraulic properties of the soil profile between pulses.

4-The dead levelling was 31.28 faster than traditional one under surged mode of irrigation; Whereas, it was 26.57% under continuous flow. It further suggests that the dead levelling is more beneficial especially under the surge irrigation

5-The moisture content decreased with increasing soil depth, especially for surge flow irrigation than in the case of continuous irrigation under the same conditions

6-There was saving in the water applied under surge irrigation system compared with continuous irrigation system by a percentages of 20.62% (162.69 m3) and 17.66% (176.044m3) under dead and traditional leveling respectively. it is enough to irrigate another area equal to 1091.37 m2 (0.259 fed.) and 899.506 m2 (0.214fed.) under dead and traditional leveling, respectively.

7-There were no differences between irrigation methods on yield of Egyptian clover (Giza 6 multi-cut type) forage green under dead leveling.

8-Egyptian clover (Giza 6 multi-cut type) yields were invariably higher in dead leveling treatments. Interestingly, the maximum average yield of surge irrigated treatments with dead leveling.

9-The water use efficiency (WUE) for surge flow irrigation treatments gave the highest values comparing with continuous flow irrigation treatment. Therefore , surge flow technique caused a great reduction in total water volume used compared to the volume used by continuous flow technique.

REFERENCES

Abd El-Hakim (2007): Rational use of surface irrigation compared to drip irrigation system. M.Sc. Thesis, Agric, Eng. Fac. Of Agric, Alex.Univ., Egypt .

Awady, M.N; M. M.Hegazi and Zaghloul (1988): Wheat response to surge irrigation. Misr J . Agric. Eng., 5 (2) :119 – 128

Bishop, A,A.; W. R. walker ; N.L. Allen and G .J. Poole (1981): Furrow advance rates surge flow system. Journal of the irrigation and Drainage Division, ASCE, 107 (IR3): 257 – 264.

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

Eid, S.M.I.(1998): Surge flow irrigation for corn and wheat under different land leveling practices in heavy clay soils. Ph.D. Thesis,S0il Sc.Dep., Fac.of Agric., Kafr El-Sheih, Tanta Univ., Egypt.

Ghallab, A. A. (1987).Evaluation of Surge irrigation for different crops.Ph. D .Thesis, Fac. Of Agric., Alex. Univ., Egypt.

Hassan.EL. Banna. O. M. (1987) The combined effect of different land levelling and improved surface irrigation methods on production of onion. Thesis of Msc. At Moshotaher,Faculty of Agric.Univ. of Zagazig. 1987.

Ismail,S.M., G. L. Westesen and W.E Larsen (1985) Surge flow border irrigation using an outomatic drop gate . Transactions of the ASAE,28(2):523-536

Lenka, D. (1991). Irrigation and drainage. First Edition, New Delhi,Cgapter 7,pp.175-181

Matter, M.A. (2001): Relationship between ploughing method and surge irrigation and its effect on water rationalization. M.Sc. Thesis, Fac. Of Ag., Kafer El-Sheikh, Tant.Univ., Egypt

Morcos,M.A .;M.A.Abu-zeid and M. A . Kassem (1996). The reliability of the mathematical models for long border and long furrows applying surge irrigation technique.. Misr J . Agric. Eng.,Cairo Univ.Irr.Conf.,3 – 4April,pp.465-500

Osman, A. M. (1991). Surge flow irrigation for corn and faba bean in Clay soil Ph. D Thesis, Soil Sc. Dep., Fac. Of Agric., Alex. Univ., Egypt.

Ress,p.(1984): Precision land leveling in tow Minia basins U. S. A .I. D.Mech. Proj.work peper No. 12. Ministry of Agric. ARE.

Seif. EL YazaL M. N. and J. A . Mcclung (1986) Methods for determining precision land leveling need in relation to water management concepts . Egypt , J.Soil Sci.special paper ,pp.189-200

Zaghloul, M. A. A. (1988). Intermittent irrigation in wheat .M. Sc.Thesis, Agric.Eng.Dep.,Fac. Of Agric., Ain Shams Univ.,Egypt.

Zein, EL- Abedin, T. K. (1988) surface irrigation simulation with kinematics wave model for continuous and surge flow regimes. M.sc.Thesis Fac. Of Agric., Alex. Univ. Egypt.

تأثير التسوية والري النبضي على ترشيد مياه الري

طارق سالم محمد، أمين حسين عواد و احمدعزت خاطر
***معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – وزارة الزراعة**

تم إجراء هذا البحث خلال موسم ٢٠١٢-٢٠١٣ بمحطة بحوث بهتيم التابعة لمركز البحوث الزراعية بمحافظة القليوبية، بمصر في التربة الطينية الثقيلة) لدراسة تأثير التسوية ونظام الري على ترشيد المياه (المياه المضافة) وتوزيع الرطوبة والانتاجية والوقت المتاح للري وكفاءة الاستخدام المائي. تم استخدام نوعين من التسوية (تقليدية ودقيقة) ونوعين من طرق الري (النبضي (٣٠ دقيقة فتح / ٢٠ دقيقة غلق)والمستمر) وملوحة المياه المستخدمة كمصدر للري كانت EC = ٦٥٠جزء في المليون. وأشارت النتائج إلى ما يلى:

١- اقل كمية مياه تم اضافتها كانت تحت طريقة الري النبضي مع التسوية الدقيقة عنة في حالة الري المستمر تحت نفس الظروف
٢- تأثير ازمنة الفتح والغلق للري النبضي على كمية الماء المضافة تؤدى الى اندماج حبيبات سطح التربة وتكوين طبقة مانع التسرب تؤدى الى تقليل كمية المياه المضافة خلال الري النبضي
٣- تتطلب معاملات الري النبضي زمنا اقل لإكمال جبهة التقدم عن التي في معاملات الري المستمر
٤- زمن تقدم المياه يقل مع الري النبضي والتسوية الدقيقة ويزداد مع الري المستمر والتسوية التقليدية بنسه ٢٠.٦٢% و١٧.٦٦% على التوالي
٥- كفاءة استخدام المياه (WUE) تحت نظام الري النبضي انخفضت مع التسوية العادية (٨.٨٩كجم/م٣) بالمقارنة مع التسوية الدقيقة (١٥.١٥ كجم/م٣). ومن جهة أخرى كانت تحت نظام الري المستمر (٧.٢٣كجم/م٣) و (١١.٧١ كجم/م٣) مع التسوية العادية والدقيقة على التوالي. كما انه لوحظ زيادة كفاءة استخدام المياه مع الري النبضي بالمقارنة بالري المستمر وخاصة مع التسوية الدقيقة حيث كانت ١٥.١٥ كجم/م٣ و١١.٧١ كجم/م٣على التوالي. وعموما لوحظ زيادة كفاءة استخدام المياه تحت نظام الري النبضي مقارنة بنظام الري المستمر في جميع معاملات الدراسة.
٦- كان هناك زيادة في الانتاجية تحت التسوية الدقيقة مقارنة بالعادية بنسبة ٢٢.٩٢%و٢٤.٠٩ % للري النبضي والمستمر على التوالي. وفى الوقت نفسه كان هناك اختلاف بسيط في الانتاجية بين الري النبضي والمستمر حيث كانت نسبة الزيادة ٢.٦ و٤.١ % للري النبضي عن المستمر في حالة التسوية الدقيقة والعادية على الترتيب
٧- كان هناك وفر في كميات المياه المضافة تحت نظام الري النبضي مقارنة بنظام الري المستمر بنسه ٢٠,٦٢% (١٦٢.٩٦متر مكعب) وهذه الكمية كافية لري مساحة تصل الي ١٠٩١,٣٧ متر مربع (٠,٢٥٩ فدان) مع التسوية الدقيقة في حين كانت هذه النسبة١٧.٦٦% (١٧٦.٠٤٤متر مكعب) وهذه الكمية كافية لري مساحة تصل الي ٨٩٩,٥٠٦ متر مربع (٠,٢١٤ فدان) مع التسوية العادية