

OPTIMIZING AMOUNT OF APPLIED WATER FOR DRIP IRRIGATION SYSTEM IN NORTH NILE DELTA

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ABSTRACT

Accurate calculation of irrigation water requirement, affects directly the crop production, water use efficiency (WUE), and energy use efficiency (EUE). Two methods for calculating irrigation water requirement were compared under two types of emitters (R and T). The first method was based on the Moisture Allowed Depletion (MAD) while the second based on meteorological data (Met). Three percentages of MAD, 50, 60, and 70% of available water were experimented. Experiment has taken place under clay soil in the north of Nile Delta (Sakha region). Results showed that the treatments based on the meteorological data have consumed less amounts of water. In addition, Met treatments recorded the greatest values of water application efficiency (WAE). WAE has been significantly affected by the method of water requirements calculation while type of emitter did not significantly affect the WAE. The meteorological based method gave the greatest values of crop production, WUE, and energy use efficiency (EUE) for both emitters. There was a decrease in the production for the 70% MAD as a result for water stress. This production decrease caused a decrease in WUE and EUE. It was recommended to use the meteorological based method for optimized amount of applied water that will keep the crop production and increase WUE, EUE, and WAE.

INTRODUCTION

The sustainability of agricultural production depends on conservation, appropriate use and management of scarce water resources especially in arid and semi-arid areas where irrigation is required for the production of food and cash crops (Douh and Boujelben, 2011).

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Irrigation process in North Delta mainly depends on surface irrigation systems which acts 88.5% of irrigation techniques in Egypt (FAO, 2009). Production of the soil in Nile Delta faces the scarcity of both crop production and water resources. Many studies recommended replacing Surface irrigation system with modern irrigation systems or improved surface irrigation (Lijovski and Cukaliev, 2002; Omran, 2004; Song *et al.*, 2007; and Baghani *et al.*, 2008). These recommendations indicated that modern drip irrigation systems will help to improve different irrigation efficiencies and water use. On the average, drip irrigation saves about 70 to 80% water when compared to conventional flooding or furrow irrigation methods (Ishfaq, 2002). Most of Nile Delta soil is clay (old) soil (Abdelkawy and Ali, 2011). (Sonbol *et al.*, 2010) Studied the effect of different irrigation systems included surface and sub-surface drip irrigation, traditional surface irrigation and gated pipes on sugar beet crop cultivated in clay soil. They found that traditional surface irrigation consumed the greatest amount of water compared to gated pipes and drip irrigation types. Drip irrigation was studied in clay soil under different crops (El-Nemr, 2002; Sonbol *et al.*, 2009; El-Sirafy *et al.*, 2011; and 2011). These studies focused on the performance evaluation of different irrigation systems and management scenarios, but none of them studied the effect of water requirements calculation methods despite the expected variation in the calculated amounts of water requirement. Amount of applied water is directly related to soil moisture distribution and irrigation time which result a direct effect on water use efficiency (WUE), water application efficiency (WAE), energy consumption, and energy use efficiency (EUE). These parameters are essential to be considered for irrigation systems' evaluating. The importance of the last two parameters has increased with the modernization of irrigation systems that made irrigation process the major energy consumer in agriculture (Abadia *et al.*, 2008). Irrigation time is mainly related to the required amount of water to be applied. There are many methods to calculate water requirement. This study will focus on two methods to calculate the water requirement 1- Based on different values of maximum allowed depletion of soil moisture content (MAD) 2- Meteorological data based calculations (Met). Water balance method expresses the required amount of water applied by the

irrigation system to compensate the water loss. The objectives of this study is comparing the effect of using two different methods of water requirement calculation to recommend one of them depending on the water saving, crop production, WAE, WUE, and EUE.

MATERIALS AND METHODS

1. Preparation of experimental area:

The field experiment has taken place in the research farm, Faculty of Agriculture, Kafrelsheikh University, Egypt (Longitude 30.95N- Latitude 31.11E- Altitude 20m). Sweet potato (Abees) was planted during the summer season 2011/2012. The tubers were planted manually on 25th of April 2012 after bean crop in a clay soil (Table 1). Plant spacing was 25cm along rows with 70cm spacing. Chisel plough (7shares) was hitched to 60hp tractor. During ploughing 630 kg/ha of $(H_2PO_4)_2$ were added to the soil. $(NH_4)_2SO_4$, k_2SO_4 , and k_2O were used to supply the soil with 126 Unit of Nitrogen and 384 Unit of Potassium per hectare. Nitrogen fertilizer was applied with two equal doses, 3 and 5 weeks after transplanting. Potassium fertilizer was added with two doses, 1 month and two months after transplanting.

Table 1: Some physical properties of the experiment soil.

| Depth | Particle size distribution, % | | | Texture | Bulk density, kg/m ³ | Field capacity (FC), % | Wilting point (WP), % | Available water (AW), % |
|-------------|----------------------------------|-------|-------|---------|------------------------------------|---------------------------|-----------------------------|----------------------------|
| | sand | silt | Clay | | | | | |
| 0-15 | 21.54 | 26.64 | 51.82 | Clay | 1280 | 45.91 | 19.69 | 26.22 |
| 15-30 | 21.55 | 26.91 | 51.54 | Clay | 1298 | 41.26 | 21.29 | 19.97 |
| 30-45 | 20.53 | 25.76 | 53.71 | Clay | 1350 | 37.78 | 23.88 | 13.90 |
| 45-60 | 20.40 | 25.98 | 53.62 | Clay | 1420 | 37.48 | 24.01 | 13.47 |
| Mean | 21.01 | 26.32 | 52.67 | | 1337 | 40.61 | 22.21 | 18.39 |

2. Variables:

2.1 Types of emitters.

Two types of on-line emitters R and T were used to apply water. Manufacturing specifications of the two emitters are listed in Table 2.

Table 2: Emitters' manufacturing specifications.

| Emitter type | Average flow rate at 10m head, l/h | Emitter exponent | classification | Manufacturing Country |
|--------------|------------------------------------|------------------|----------------|-----------------------|
| T | 4.14 | 0.59 | Short path | Egypt |
| R | 5.48 | 0.70 | Turbulent flow | Jordan |



Fig. 1: Emitters' design and internal components.

Distribution uniformity (DU) indicator was used to express how the emitters can distribute water uniformly to the crop or soil (Burt *et al.*, 1997). Distribution not only can deprive portions of the crop of needed water, but, furthermore, can over-irrigate portions of a field, leading to water-logging, plant injury, salinization, and transport of chemicals to the ground water (Solomon 1983). In order to measure DU, laterals were imaginary divided into 4 quarters. At 10m operation head, samples of 7 emitters from each quarter were chosen to measure the flow rate of the chosen emitters. Graded cup 1 ml accuracy was put under each emitter sample all at once for 2 minutes to calculate the emitters' flow rate.. DU was calculated using the following equation (Marriam and Keller, 1978):-

$$DU = 100 \frac{q_{lq}^-}{q^-} \dots\dots\dots 1$$

Where: q^- = average of emitters flow rates , l/h, and q_{lq}^- =mean of lowest one-fourth of emitter flow rates ,l/h.

2.2 Water requirement calculation procedures.

Amount of applied water in the field work was based on two methods of water requirement calculation. The first method is based on the soil moisture allowed depletion (MAD) as a percentage of available water. (FAO, 1998) recommended 65% as the fraction of MAD for sweet potato. In this study, three percentages of (MAD) 50, 60, and 70% of available water were studied. Second method is based on the meteorological data (Met) which will result the reference evapotranspiration (ET_o). In order to monitor soil moisture content to decide the start time of irrigation process and amount of applied water, average of soil moisture content for the root zone at depths 15, 30, 45, 60cm from soil surface was measured using gravitational method after 24 hours from the start of irrigation process.

Measurement of soil moisture content was replicated every 4 hours after the first 24 hours. In case of reaching the decided MAD, the irrigation process starts till reaching the FC moisture content. Met method data were cited from CLIMWAT computer program (FAO, 1993) for Sakha meteorological station which covers the experimental area. CLIMWAT program provides users with the average of daily reference evapotranspiration ET_o values (ET_o , mm/day) during each month of the experiment season. Amount of applied water calculation was done according to the methodology of (Sepaskhah and Ghahraman, 2004).

$$ET_c = ET_o . K_c . K_r \dots\dots\dots 2$$

Where: K_c = crop factor which took the values 0.5, 1.15, and 0.65, for the initial, mid, and late growing periods of crop, (FAO, 1998). K_r was calculated during the season from the ground cover (GC) value (Keller and karmeli, 1974)

$$K_r = \frac{GC}{0.85} \dots\dots\dots 3$$

Irrigation frequency IF for the meteorological based method was calculated using equation 4.

$$IF = \frac{0.01(FC - WP)}{ET_o} . D . MAD \dots\dots\dots 4$$

Where D= root depth, mm. The MAD in this case was 65% of available water referring to (FAO, 1998). Irrigation frequency has changed according to the change in monthly ET_o values.

3. Statistical design:

Split Plot design was used in the experimental work. Emitter type (E) was the main plot while the water requirement calculation method was the sub-plot. Irristat 5.0 software was used to obtain the analysis of variance. Mstat 2.0 software was used to perform Duncan's mean comparison test.

4. Irrigation network layout:

The network was a part of the drip irrigation network of the research farm of Faculty of Agriculture, Kafrelsheikh University. The pump, chemigation, and filtration components (Media filter and 250 mesh screen filter) were exist to serve the whole farm. In the case of need to operate the experiment network the operator made a check for the availability of required pressure which was 10m. The calculations of power and energy

were based on the design of the experimental network. The available pump was a centrifugal electric pump, 20 hp (14.9 kW). Main line, Sub-main line, and manifolds were P.V.C pipes with 63, 30, and 25mm inside diameter. Laterals were 30m length with 16mm inside diameter. A schematic diagram for the experimental network is as shown in Figure. 2.

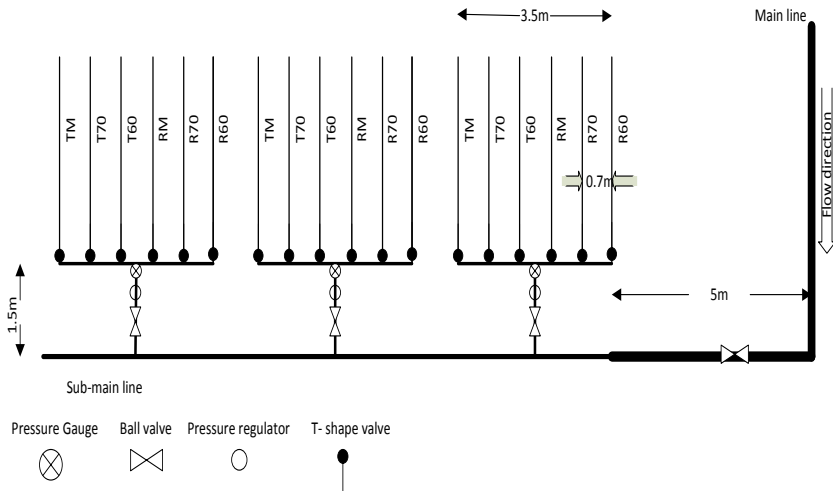


Fig. 2: A scheme for the lay out of the experiment irrigation network.

5. Water application efficiency (WAE):

Application efficiency relates to the actual storage of water in the root zone to meet the crop water needs in relation to the water applied to the field. It might be defined for individual irrigation or parts of irrigations (irrigation sets). Irrigation efficiency can be defined as shown in equation 5, (James, 1988).

$$E_a = \frac{V_{bu}}{V_a} \times 100 = \frac{RAW \cdot A}{V_a} \times 100 \dots\dots\dots 5$$

Where: - V_{bu} = volume of water beneficially used by a crop in an area. (m^3), V_a = volume of water applied in the area (m^3), A = irrigated area, m^2 , and RAW = readily available water, m which was calculated referring to (FAO, 1998).

$$RAW = MAD.TAW \dots\dots\dots 6$$

Where: TAW is the total available water which is the difference between soil field capacity (FC) and wilting point (WP). The mean value of FC

and WP shown in Table 1 was used in calculations. The measuring of Ea was replicated three times during the experiment season.

6. Crop production

Manual harvesting started after 120 days from the transplanting date. Tuberos roots for each treatment were weighed on 3 digits accuracy scale. The mean of three replicates was used to express each treatment production.

7. Water use efficiency (WUE):

WUE has been used to describe the relationship between sweet potato crop production and the total amount of water used. It was determined in kg m⁻³ by applying the following equation (Jensen, 1983):

$$WUE = \frac{Y}{W_a} \dots\dots\dots 7$$

Where: Y = total yield, kg/ ha, and W_a = total applied water, m³/ha.

8. Energy use efficiency (EUE):

In order to calculate the energy consumption of the irrigation network under the experimental conditions. The water pumping power requirement has to be calculated. The pump brake power was calculated as follows:-

$$BP_E = \frac{P_w}{\eta} \dots\dots\dots 8$$

Where: BP_E= engine brake power in hp, P_w= water power, hp and η= decimal pump efficiency which was assumed 0.7.

$$P_w = \frac{Q.H_t . \omega}{75} \dots\dots\dots 9$$

Where:

Q= required discharge at the network m³/s, H_t= total head m, and ω = water specific weight kg/ m³.

$$H_t = H_f + H_s + H_e \dots\dots\dots 10$$

H_f =friction loss in m/100m, H_s =static head, and H_e =emitter operating pressure head in m. The suction static head was 125m. Hazen- Williams formula (Hazen and Williams, 1920) was used to calculate the major friction loss for which included main, sub-main, manifold, and laterals losses. The constant C value was 150.

$$H_f = \frac{10.67 \times Q^{1.85}}{C^{1.85} \times d^{4.87}} \dots\dots\dots 11$$

Where: d = inside pipe diameter in m. The minor friction loss in connectors and valves was assumed 10% of the total friction loss (El-Gindy *et al.*, 2001).

Energy consumption and Energy Use Efficiency (EUE):

The Energy was calculated by multiplying the calculated power requirement (kW.h) in the total operation time per season for each treatment. EUE indicator was used to express the crop produced from energy unit according to the following equation:

$$EUE = \frac{\text{Total yield, kg}}{P_w} \dots\dots\dots 12$$

RESULTS AND DISCUSSIONS

1. Distribution uniformity (DU):

Distribution uniformity of T and R emitters were 89.23 and 82.89% respectively, at 10m head. Emitter exponent of emitter T was greater than its value of emitter R at the network operation head. Obtained values of DU reflect the expected higher uniformity of emitter T than emitter R referring to the emitter exponent values (James, 1988).

2. Amount of applied water.

The results showed that R emitter treatments consumed higher amounts of applied water than T emitter treatments. Increasing the MAD from 50 to 70% led to a decrease in the amount of applied water by 20.14, and 22.27% respectively for the R and T emitters. The R70 and T70 were the only MAD based treatments which consumed lower amounts of water than the meteorological based calculations method. For T emitter 4.6% of water consumed by T_{Met} treatment will be saved if compared to T70 treatment. For R emitter 1.69% of water consumed by T_{Met} treatment will be saved if compared to T70 treatment. The water saving in T emitter may be due to the higher DU it shows. The higher DU means avoiding over irrigation and better soil moisture distribution leads to delay the water loss (Solomon, 1983).

Table 3: Amounts of applied water for the experiment treatments over the growing season m³/ ha.

| | | | |
|------------------------|---------|------------------------|---------|
| R50 | 5234.59 | T50 | 5218.90 |
| R60 | 4709.91 | T60 | 4649.83 |
| R70 | 4180.34 | T70 | 4056.81 |
| R_{Met} | 4252.28 | T_{Met} | 4252.28 |

3. Water application efficiency (WAE).

The T emitter showed higher values of water application efficiency than the facing treatments of R emitter. Data listed in Table 4 showed that for the MAD based application method for both emitters, greater amount of applied water per irrigation event resulted higher WAE values. These results agree with (Sonbol *et al.*, 2011; Tariq and Hussain, 1998) who mentioned that surface drip irrigation consumed much water if compared to sub-surface drip irrigation but resulted higher values of WAE. High water holding capacity feature of clay soil gives the ability of keeping great amounts of water in the root zone. Values of WAE were in agreement with the expected range of drip irrigation system shown by (Howell, 2003). The amount of applied water based on Meteorological data showed the greatest values of WAE for both emitters R and T if compared to MAD based application method. This may give an indicator that the meteorological based method reduces the opportunities of water loss in the root zone. Table 5 shows the analysis of variance for WAE observation resulted from the experimental variables. Water requirements calculation method had a highly significant effect on the water application efficiency, while the emitter type and interaction between the studied variables had no significant effect on WAE. This may be clarified by the mean comparison test of crop production shown in Table 4, which pointed out there was no significant difference at 0.05 level between all treatments except R60 and R70. This was in agreement with the results shown by (William and Niemiera, 1993) who mentioned that the application efficiency was unaffected by the emitters' application rate but affected by the moisture content. Comparing the T_{Met} treatment with the greatest WAE values for T and R emitters individually, shows that using meteorological method will increase WAE by 3.17, and 5.35% for the two emitters respectively.

Table 4: Water application efficiency values and mean comparison.

| | | | |
|------------------------|-----------|------------------------|-----------|
| R50 | 88.76 ABC | T50 | 91.74 ABC |
| R60 | 86.10 BC | T60 | 87.27 ABC |
| R70 | 85.38 C | T70 | 86.74 ABC |
| R_{Met} | 93.78 AB | T_{Met} | 94.74 A |

Note: Values followed by single letter is significantly different at 0.05 level.

L.S.D= 8.372

Table 5: Analysis of variance (ANOVA) of variables effect on WAE.

| Source of Variation | DF | Sum of Squares | Mean squares | F Ratio |
|---------------------|----|----------------|--------------|----------|
| Emitter(E) | 1 | 16.67 | 16.67 | 0.71 ns |
| Method(M) | 3 | 724.33 | 241.44 | 10.32 ** |
| ExM | 3 | 33.67 | 11.22 | 0.48 ns |
| Residual | 16 | 374.33 | 23.40 | |
| Total | 23 | 1149.00 | 49.96 | |

4. Crop production.

Data listed in Table 6 show the obtained crop production for the experimental treatments. The greatest crop production was under Met based calculation treatments for both emitters. For the MAD based method of T emitter, treatment T60 gave the greatest production with 46.75 Mg/ha while the lowest was at T70 treatment with 24.31 Mg/ha. Reduction of crop production shown at T70 and R70 treatments may result due to the water stress occurrence on the plants as the maximum MAD for sweet potatoes is 0.65 (FAO, 1998). Crop production did not follow the trend of WAE. The crop production in T60 and R60 was higher than T50 and R50 despite their higher WAE. This may be due to the nature of sweet potato plants. The economic part of sweet potato is the root. It is directly affected by soil moisture stress. The higher MAD led to wider roots as the MAD was kept in acceptable ranges. This may explain the crop reduction in 70% MAD treatments for both emitters R and T.

Table 6: Sweet potato crop production, Mg/ha

| | | | |
|------------------------|-------|------------------------|-------|
| R50 | 30.48 | T50 | 38.14 |
| R60 | 41.93 | T60 | 46.75 |
| R70 | 22.15 | T70 | 24.31 |
| R_{Met} | 43.03 | T_{Met} | 47.88 |

5. Water use efficiency (WUE).

Table 7 shows the values of WUE for different treatments. The greatest value of WUE was at T_{Met} while the lowest was obtained at R70

treatment. The higher values of WUE for the meteorological based treatments under both emitters may be due to the higher production and less amounts of applied water if compared to 50 and 60% MAD treatments. The MAD based treatments showed that, 60% percentage for both emitters gave greater values of WUE than the two other percentage for both emitters. The meteorological data based method led to increase the WUE by 10.75 and 12.05% of the maximum WUE obtained from the meteorological based treatments treatments for T and R emitters respectively, if compared to T60 and R60 treatments. This may be due to the lower difference in crop production for t emitters at treatments T_{Met} and T60 than the difference of crop production for the same treatments of R emitter.

Table 7: Water use efficiency kg/m³ for different treatments.

| | | | |
|------------------------|-------|------------------------|-------|
| R50 | 5.82 | T50 | 7.31 |
| R60 | 8.90 | T60 | 10.05 |
| R70 | 5.30 | T70 | 5.99 |
| R_{Met} | 10.12 | T_{Met} | 11.26 |

6. Energy use efficiency (EUE).

For irrigation networks have T and R emitters in their laterals, the power requirements per hectare were 6.4, and 8.5 kW for T and R emitters respectively. Emitter R treatments showed less values of consumed energy than T emitter treatments as shown in Table 8. This may be due to the higher flow rate of emitter R which caused less operation time for irrigation process. On the other hand EUE values of T emitter treatments were higher than R emitter treatments. Meteorological based method recorded the greatest values of EUE. Treatment T_{Met} gave the greatest value of EUE with a value of 277.08 kg/kW.h. The percentage 60% MAD showed the highest values. Referring to (Ozkan *et al*, 2004 and singh *et al.*, 2002), the higher DU and WAE of T emitter caused the increase in EUE.

Table 8: Energy consumption and EUE of different experiment treatments.

| | Operation time h/season | Energy consumption kW.h | Energy use efficiency kg/kW.h |
|------------------------|----------------------------|----------------------------|----------------------------------|
| R50 | 31.82 | 196.69 | 154.96 |
| R60 | 31.51 | 192.36 | 217.98 |
| R70 | 30.69 | 188.87 | 117.28 |
| R_{Met} | 27.00 | 164.99 | 260.81 |
| T50 | 23.14 | 203.65 | 187.28 |
| T60 | 22.63 | 201.66 | 231.82 |
| T70 | 22.22 | 196.42 | 123.77 |
| T_{Met} | 19.41 | 172.80 | 277.08 |

CONCLUSION

Depending on the meteorological based method for optimized calculation of water requirement under the experimental conditions, leads to water saving, higher crop production, WUE, EUE. The higher DU the emitter can achieve will increase the WAE, WUE, and EUE. Amount of applied water will significantly affect the WAE while emitter type has no significant effect. In case of meteorological data absence, MAD should not exceed 60-65% of available water for obtaining higher WUE and EUE. More studies should be done for comparing different methods of water requirement calculation including different soil and emitter types.

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الملخص العربي

ضبط كمية المياه المضافة بنظام الري بالتنقيط في شمال دلتا النيل

ا.م.خليفة^١، م.ك. النمر^٢، م.ا. مليحة^٣، م.م. شرف^٤

يمثل نظام الري السطحي ٨٨,٥% من إجمالي نظم الري المستخدمة في منطقة الدلتا. ونظراً للحاجة لتعظيم الاستفادة من كفاءة الري، كفاءة استخدام المياه والطاقة، فإن العديد من الدراسات قد اوصت باستخدام نظام الري بالتنقيط تحت ظروف التربة الطينية التي تحتل الجزء الأكبر من أنواع التربة الموجودة في شمال الدلتا. تنعكس دقة الحسابات للاحتياجات المائية للمحصول انعكاساً مباشراً على كمية المياه المضافة، كمية المياه المخزنة في مجال الجذور، كفاءة استخدام المياه، زمن تشغيل الشبكة وتوفير الطاقة. في إطار ضبط كمية المياه المضافة من خلال نظام الري بالتنقيط، أجريت دراسة حقلية لمحصول البطاطا لموسم ٢٠١٢ باستخدام نظام الري

١- أستاذ ورئيس قسم الهندسة الزراعية - كلية الزراعة- جامعة كفر الشيخ.

٢- مدرس بقسم الهندسة الزراعية - كلية الزراعة- جامعة دمياط.

٣- أستاذ باحث متفرغ- معهد بحوث ادارة المياه وطرق الري - المركز القومي لبحوث المياه- القاهرة.

٤- حاصل على درجة الدكتوراه.

بالتنقيط تحت ظروف التربة الطينية. شملت الدراسة استخدام نوعين من النقاطات R, T لإضافة الاحتياجات المائية المحسوبة بطريقتين الأولى تعتمد على نسبة الاستنفاد الرطوبي المسموح به في التربة والثانية بالحساب المعتمد على البيانات المناخية. تم اختبار ثلاث نسب من المحتوى الرطوبي المسموح باستنفاده وهي ٧٠،٦٠،٥٠% من الماء الميسر مع طريقة حساب الاحتياجات المائية الأولى. وقد أظهرت النتائج أن الحساب على أساس البيانات المناخية لكلا النقاطين يوفر المياه مقارنة بالطريقة المعتمدة على النقص الرطوبي المتاح للنسب ٦٠،٥٠% بينما استهلكت النسبة ٧٠% أقل كمية من المياه. وقد أدى الحساب على أساس البيانات المناخية إلى رفع كفاءة الإضافة بنسبة ٣،١٧،٥،٣٥% للنقاطين R و T على الترتيب مقارنة بأعلى كفاءة إضافة ناتجة من الحساب على أساس نسبة الاستنفاد الرطوبي والتي تحققت عند النسبة ٥٠% لكلا النقاطين. أظهر تحليل التباين تأثير طريقة الحساب معنوياً على كفاءة الإضافة وعدم تأثير اختلاف نوع النقاط. انعكست كفاءة الإضافة على إنتاج محصول البطاطا فحققت المعاملات R_{Met} , T_{Met} أعلى قيم لإنتاج المحصول بلغت ٤٧،٨٨، ٤٣،٠٣ طن/هكتار على الترتيب. هذا الارتفاع في الإنتاج مع التوفير في كمية المياه المضافة أدى إلى ارتفاع في كفاءة استخدام المياه للمعاملات المحسوبة على أساس مناخي. أظهرت الدراسة أن أعلى كفاءة استخدام للطاقة وصلت إلى ٢٧٧،٠٨ كج/ك واط. س عند المعاملة T_{Met} وبالنسبة للنقاط R سجلت المعاملة المعتمدة على البيانات المناخية أعلى كفاءة استخدام طاقة بلغت ٢٦٠،٨١ كج/ك واط. س مقارنة بباقي المعاملات بالنسبة لنفس النقاط. من النتائج السابقة في حال عدم توفر بيانات مناخية والرغبة في الاعتماد على نسب استنفاد الرطوبة المسموح بها فإنه يوصى باستعمال النسب من ٦٠-٦٥% من الماء الميسر لتجنب انخفاض الإنتاج والتوفير في كمية المياه المضافة. كما أوصت الدراسة بالاعتماد على البيانات المناخية في حساب الاحتياجات المائية من أجل ضبط كمية المياه المضافة لنظام الري بالتنقيط في أراضي شمال الدلتا مما يؤدي إلى توفير المياه وزيادة الإنتاج بما يتبعه من زيادة لكفاءة الإضافة، كفاءة استخدام المياه، كفاءة استخدام الطاقة.