IRRIGATION MANAGEMENT AND THE PRODUCTION OF SORGHUM UNDER CALCARCEOUS SOIL

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ABSTRACT

In general, irrigation by surface methods is the most common to supply crops with frequent application of water. Pressurized irrigation systems have been introduced in Egypt to develop new irrigation technology suited to limited water supply as well as to specific topographic and soil conditions. In this study, a field experiment was carried out in the Agricultural Experimental Station of the Desert Research Center, Maryut, Alex. Governorate during the two successive seasons of 2006 and 2007. Five methods of irrigation were studied: gated pipe (GP), surface drip irrigation, one line of drippers for one line of plants (D1:1), surface drip irrigation, one line of drippers for two lines of plants (D1:2), sub-surface drip irrigation, one line of drippers for one line of plants (SD1:1) and sub-surface drip irrigation, one line of drippers for two lines of plants (SD1:2). The irrigation methods were conducted under three water quantities (100%, 70%, and 50%) of reference $E_{T_0}$ calculated by modified Penman-Monteith equation, with two soil water depletion levels (30% and 50%) of available water. The statistical analysis revealed highly significant increases in all the studied parameters with increasing water quantities. The maximum fresh weights i.e., 41.73, 41.51, and 39.66 ton fed. were obtained with SD1:1, D1:1, and GP, respectively under water quantity 100% (Q1) and soil water depletion 30% (D1) in the year 2006 while the maximum dry masses of 8.23, 8.24, and 7.91 ton fed. Respectively were achieved under SD1:1, D1:1, and GP with Q1 and D1. In 2007, the maximum fresh masses were, 42.55, 41.85, and 40.53 under D1:1, SD1:1, and GP, while the maximum dry weights were 8.4, 7.98, and 7.27 ton fed. Respectively under D1:1, GP, and SD1:1 with Q1 and D1. The study showed that water use efficiency decreased by increasing quantity of the applied water.

KW: WUE, Evapotranspiration, Sub-Surface Drip Irrigation (SD1), Drip Irrigation (D1), Gated Pipe (GP), Soil depletion.

1 Assistant researcher in Desert Research center; 2, 3 Resp. Prof. Em and Assoc. Prof., Ag. Eng. Dept., Fac. Ag., Benha U., and 4 Prof. Doctor of water requirement, Desert Research Center.

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INTRODUCTION

Water is the most limiting factor for plant production in arid and semiarid regions, and when the source of water is limited, the demand for water increases and water management will become an essential practice used by farmers. The relationships between yield and water consumption were established and the preferred irrigation programs to be used with surface irrigation were developed (Tekinel et al., 1999), (Fischbach and Somerholder, 1971) found that an automatic surface irrigation system with gated pipe (GP) and reuse system can be very efficient in applying irrigation water (91.9% efficiency). Micro irrigation has been developed rapidly since the early 1960s. Some advantages of micro irrigation include improved water management and yield, greater control of applied water resulting in less water and nutrient loss through deep percolation. (Phene et al., 1987) demonstrated that significant yield increases in tomatoes were achieved with the use of high frequency subsurface drip irrigation (SDI) and precise fertigation management. (Hutmacher et al., 1996) demonstrated that yield of alfalfa production increased upon using SDI system buried at a depth of 0.7 m. Cotton yield has also been improved using SDI system (Smith et al., 1991) and (Ayars et al., 1998). Water use efficiency has been significantly improved through the use of subsurface drip irrigation SDI (Phene et al., 1986b). The objective of this study is to improve water management, irrigation efficiency and water use efficiency with gated pipe (GP), surface drip irrigation (DI) and subsurface drip (SDI) irrigation systems.

MATERIALS AND METHODS

A field experiment was carried out in Maryout Agricultural Research Station (محلة التجارب الحليلية بمرج) south west of Alexandria (elevation 12.75 m, latitude 31°22' N and Longitude 29°27' E) during the two successive seasons 2006 and 2007. The study was conducted under split split design with three replicates to evaluate the influence of pressurized irrigation systems (gated pipe, surface and subsurface drip irrigation) and water management practices represented by the applied water depth and water distribution uniformity on:

1- Consumptive use,
2- Water use efficiency,
3- Production of sorghum represented by yield and yield components under calcareous soil condition.

1 Soils of the studied area.

The area of study was represented by a soil profile from which five depths were sampled i.e. (0 -20, 20 - 40, 40 - 60, 60 - 80 and 80 - 100 cm). The soil samples were air dried, ground and sieved through a 2 mm screen to get the fine part of soil which is kept for analysis.

The chemical and physical properties of the collected soil samples were determined according to the standard methods outlined in the following:
- Particle size distribution by the pipette method as described by (Klute, 1986).
- Particle density (dp) according to (Richards, 1954).
- Bulk density (db) by soil cores method according to (Richards, 1954).
- Porosity was calculated using the equation: Porosity% = ( (dp - db) / dp) × 100.
- Calcium carbonate content was determined by Collin's calcimeter according to Richards (1954).
- PF curves and soil moisture retention at 0.33 (corresponding to soil field capacity) and 15 bar (corresponding to soil wilting point) were determined in the undisturbed soil cores using the pressure cooker and pressure membrane, respectively, according to Singh (1980) and results obtained are presented in Table (2).
- The filtration rate was determined by using the double ring infiltrometer as described by Kohneke (1980).
- Cationic and anionic composition, pH and EC of the soil saturation extract were determined according to Richards (1954).
Soil organic matter content was determined according to the method of Valky and Black (Jackson, 1967).

Caution exchange capacity was determined using TaOAc-NH4OAc according Richards (1954). Exchangeable cautions were extracted using NH4OAc method (Jackson, 1973) and determined as outlined by Black (1965).

Data set out in Tables 1, 2, 3 and 4 reveal that the studied soil is generally loamy-textured except for the surface (0-20 cm) and deepest (80-100 cm) layers which are of a sandy-loam texture. Total calcium carbonate content increased slightly with depth and ranged from 26.5% to 30.1%. Also, the soil bulk density increased with depth and varied between 1.42 and 1.57 g/cm³.

The soil reaction is moderately alkaline; where soil pH ranged from 7.5 to 7.7. Electrical conductivity of soil paste extract indicates that soil is slightly saline, where ECe values varied from 2.8 at (40-60 cm depth) to 3.9 dS/m⁻¹ at the surface layer. The soil saturation extract showed that Na⁺ and Ca²⁺ were the dominant cautions while Cl⁻ was the dominant anion followed by SO₄⁻ and HCO₃⁻.

### Table (1): Some soil physical properties of the studied soil:

<table>
<thead>
<tr>
<th>Soil depth (cm)</th>
<th>Organic matter (%)</th>
<th>Bulk density (g/cm³)</th>
<th>Particle density (g/cm³)</th>
<th>Ponderosity</th>
<th>Infiltration Rate (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>0.63</td>
<td>7.6</td>
<td>4.09</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>20-40</td>
<td>0.22</td>
<td>7.8</td>
<td>3.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-60</td>
<td>0.49</td>
<td>7.5</td>
<td>3.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-80</td>
<td>0.58</td>
<td>7.6</td>
<td>3.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-100</td>
<td>0.33</td>
<td>7.7</td>
<td>3.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table (2): Soil moisture retention curve (pf) (w/w %) of the studied soil.

<table>
<thead>
<tr>
<th>Soil depth (cm)</th>
<th>Soil moisture retention (%)</th>
<th>Available soil water (cm³/g)</th>
<th>Available soil water (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>13.09</td>
<td>15.11</td>
<td>185.8</td>
</tr>
<tr>
<td>20-40</td>
<td>13.14</td>
<td>15.22</td>
<td>199.2</td>
</tr>
<tr>
<td>40-60</td>
<td>13.37</td>
<td>15.37</td>
<td>207.2</td>
</tr>
<tr>
<td>60-80</td>
<td>13.14</td>
<td>14.21</td>
<td>206.2</td>
</tr>
<tr>
<td>80-100</td>
<td>13.22</td>
<td>14.21</td>
<td>206.2</td>
</tr>
</tbody>
</table>

### Table (3): Some chemical properties of the soil under study

<table>
<thead>
<tr>
<th>Soil depth (cm)</th>
<th>Organic matter (%)</th>
<th>pH (soil water suspension)</th>
<th>ECe (dS/m)</th>
<th>Cation exchange at 1 cm³ L⁻¹</th>
<th>Anions (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>0.63</td>
<td>7.6</td>
<td>4.09</td>
<td>22.7</td>
<td>6.21</td>
</tr>
<tr>
<td>20-40</td>
<td>0.22</td>
<td>7.8</td>
<td>3.48</td>
<td>20.0</td>
<td>5.02</td>
</tr>
<tr>
<td>40-60</td>
<td>0.49</td>
<td>7.5</td>
<td>3.09</td>
<td>18.7</td>
<td>6.68</td>
</tr>
<tr>
<td>60-80</td>
<td>0.58</td>
<td>7.6</td>
<td>3.28</td>
<td>21.1</td>
<td>7.51</td>
</tr>
<tr>
<td>80-100</td>
<td>0.33</td>
<td>7.7</td>
<td>3.47</td>
<td>23.5</td>
<td>8.40</td>
</tr>
</tbody>
</table>
2. Meteorological data.
Data in Table 5 through the summer season (Jun to Oct.) indicates that the average maximum air temperature value ranges between 27.00°C and 31.2°C while the minimum temperature value ranges from 17°C in Oct to 24.4°C in September.

The relative humidity is nearly high and reaches its maximum value in July 70.0%.

The sunshine hours vary from 12.0h in July to 9.2h in October while the wind velocity ranges from 2.81 m/sec in October to 3.92 m/sec in July.

The total rainfalls occurred through September and October months were 5.58 and 59.49 mm, respectively.

Table 5: Meteorological data of Maryut area as average of 30 years

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>17.50</td>
<td>17.50</td>
<td>22.50</td>
<td>25.00</td>
<td>27.50</td>
<td>30.00</td>
<td>30.00</td>
<td>32.50</td>
<td>30.00</td>
<td>27.50</td>
<td>23.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Range</td>
<td>7.50</td>
<td>7.50</td>
<td>12.50</td>
<td>15.00</td>
<td>20.00</td>
<td>22.50</td>
<td>22.50</td>
<td>20.00</td>
<td>17.50</td>
<td>14.00</td>
<td>10.00</td>
<td>15.13</td>
</tr>
</tbody>
</table>

Table 4: CaCO3 content, CEC and exchangeable Cations of the soil under study

<table>
<thead>
<tr>
<th>Soil</th>
<th>CaCO3</th>
<th>CEC</th>
<th>Exchangeable Cations (Cmole kg-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>28.50</td>
<td>20.06</td>
<td>7.15 1.42 8.36 2.93</td>
</tr>
<tr>
<td>20-40</td>
<td>28.90</td>
<td>19.42</td>
<td>7.11 1.31 8.31 2.87</td>
</tr>
<tr>
<td>40-60</td>
<td>28.80</td>
<td>19.62</td>
<td>7.48 1.17 8.77 2.97</td>
</tr>
<tr>
<td>60-80</td>
<td>29.50</td>
<td>20.24</td>
<td>8.07 1.23 8.21 2.71</td>
</tr>
<tr>
<td>80-100</td>
<td>30.10</td>
<td>20.24</td>
<td>8.07 1.23 8.21 2.71</td>
</tr>
</tbody>
</table>

RH: relative humidity %
Ra: net radiation at the crop surface (MJ m^-2 day^-1)
G: soil heat flux density (MJ m^-2 day^-1)
S: slope of the saturation vapor pressure curve (1.08:1.34) average 1.26
Rg: solar radiation in equivalent evaporation (mm/day)

3. Irrigation systems.
Three irrigation systems were used to irrigate the grown plant. The system consists of a diesel pump (18m^3/h, flow rate), it takes water from open subsurface tank (75m^3) capacity through two filter units, the first one is a screen (130 meshes) and the other is a gravel filter.

The filtration system is controlled, by safety valve, relief valve, four control valves, pressure regulator unit, flow meter unit, air tank (balloon) unit, 6.4 mm pressure meter.

The manifold is 50 -- mm PVC pipeline with 50 mm end plug for flushing. The drippers (emitters) were with a flow rate of 4L/h (GR) installed in 16 mm polyethylene laterals.

The filtration system is controlled, by safety valve, relief valve, four control valves, pressure regulator unit, flow meter unit, air tank (balloon) unit, 6.4 mm pressure meter.

The manifold is 50 -- mm PVC pipeline with 50 mm end plug for flushing. The drippers (emitters) were with a flow rate of 4L/h (GR) installed in 16 mm polyethylene laterals.

Fig 1: The irrigation system and treatments.
3-1 - Surface drip irrigation (two techniques)
   a) One line of drippers (GR 4 l/hr and the distance between drippers is 50 cm) for one line of plants (D1:1).
   b) One line of drippers for two lines of plants (D1:2).

3-2 - Subsurface drip irrigation.
   a) One line of drippers (GR 4 l/hr and the distance between drippers is 30 cm) for one line of plants (SD1:1).
   b) One line of drippers for two lines of plants (SD1:2).

3-3 - Gated pipes (GP).
160 mm in diameter aluminum pipes were used with gates located at 70 cm spacing. The one gate discharge is 0.5 L/s.
The system consists of a diesel pump (18 m³/h, flow rate), it takes water from open subsurface tank (c75 m³) capacity through two filter units, the first one is a screen (150 mesh) and the other is a gravel filter.

4- Measuring of discharge (Q).
According to Awady, (1978) the discharge was measured by a direct method using volume and time. This is one of the simplest and most accurate methods, the equation is 

\[ Q = \frac{v}{t} \]

Where
\[ Q \] = discharge in (L/h)
\[ V \] = volume in (liter)
\[ t \] = time (hour)

RESULTS AND DESCUSION

1- Effect was studied of soil water depletion on fresh and dry masses (ton/fed.) of first and second cuts of the sorghum plants grown in the two studied seasons.

2- Results in illustrated graphically in Figs. 2 and 3 indicate that irrigation under 30% soil water depletion resulted in significantly higher values for fresh and dry weights of the sorghum plants in both cuts of both the two seasons of cultivation. These results agree with those of Byer and Mcphphrsho (1975), Eck (1986) and Hawell et al. (1995).

Fig (2): Effect of soil water depletion on fresh mass (ton/fed.) of first and second cuts of the sorghum grown in the two studied seasons.

Fig (3): Effect of soil water depletion on dry mass (ton/fed.) of first and second cuts of the sorghum grown in the two studied seasons.

3- Effect of irrigation water quantity on fresh and dry masses (ton/fed.) of first and second cuts of the sorghum grown in the two seasons.

Fig (4 and 5) indicate that water quantities had significant effects on fresh and dry weights of the first and second cuts of the sorghum plants grown in the two seasons. The highest values of yield were noticed under the applied irrigation water quantity (100%) of reference evapotranspiration (ET₀). These results stand in well agreement with those of (Neelan and Rajput, 2007) who found that irrigation levels resulted in significant differences in both years on yield and its component.
Fig (4): Effect of irrigation water quantity on fresh mass (ton/fed.) of the first and second cuts at the two studied seasons.

Fig (5): Effect of irrigation water quantity on dry mass (ton/fed.) of the first and second cuts of the sorghum plants in the two studied seasons.

Effect of the irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum plants in the two studied seasons.

Fig (6): Effect of irrigation system on fresh mass (ton/fed.) of the first and second cuts of sorghum grown in the two studied seasons.

Fig (7): Effect of irrigation system on dry mass (ton/fed.) of the first and second cuts of sorghum grown in the two studied seasons.

5- Effect of interaction between soil water depletion and irrigation water quantity on fresh and dry masses (ton/fed.) of first and second cuts in the two studied seasons.

(Phene et al., 1987) who demonstrated significant yield increases with the use of high frequency SDI. (Hutmacher et al., 1996) demonstrated yield increases in alfalfa production using SDI.
Data of interaction effect between soil water depletion and water quantities on fresh and dry weights at the two studied seasons indicated that, increasing water quantities together with 30% soil water depletion resulted in highly significant increases in both fresh and dry yields of the 1st and 2nd cuts in both the two successive cultivation seasons. On the other hand, decreasing applied water quantities with increasing soil water depletion caused fresh and dry weights of the first and second cuts in the two successive seasons to decrease. These results coincide with those of Eck (1986).

Fig (8): Effect of interaction between soil water depletion (30%) and irrigation water quantity on fresh and dry mass (ton/fed.) of the first and second cuts of sorghum grown in the two successive seasons.

Fig (9): Effect of interaction between soil water depletion (50%) and irrigation water quantity on fresh and dry mass (ton/fed.) of the first and second cuts of sorghum grown in the two successive seasons.

Fig (10): Effect of interaction between soil water depletion (30%) and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum grown in the two seasons.
7- Effect of the interaction between irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of the sorghum grown in the two successive seasons

The interaction effects between water quantities and irrigation systems on fresh and dry weights for two cuts in the two seasons are presented in Table(6). The interaction between water quantity applied at 100% ET and the irrigation systems D1:1 and SD1:1 seemed to be of the highest significant effect on fresh and dry weights of the first and second cuts of sorghum grown in both the studied two seasons.

8- Effect of the interaction between soil water depletion, irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts of sorghum grown in the two seasons

The results presented in Table(7) indicated that the maximum values of fresh and dry masses were noticed under the interaction between 100% ET and soil water depletion 30% with D1:1 irrigation system.
Table (7): Effect of soil water depletion, irrigation water quantity and irrigation system on fresh and dry masses (ton/fed.) of the first and second cuts at two seasons.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Water quantity</th>
<th>Fresh mass (ton/fed.)</th>
<th>Dry mass (ton/fed.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; season</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; season</td>
</tr>
<tr>
<td>Depletion</td>
<td>Irr. system</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; cut</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; cut</td>
</tr>
<tr>
<td>100%</td>
<td>GP</td>
<td>24.14</td>
<td>15.52</td>
</tr>
<tr>
<td>100%</td>
<td>D 1:1</td>
<td>25.82</td>
<td>15.69</td>
</tr>
<tr>
<td>100%</td>
<td>D 1:2</td>
<td>21.97</td>
<td>13.16</td>
</tr>
<tr>
<td>100%</td>
<td>SD 1:1</td>
<td>25.86</td>
<td>15.87</td>
</tr>
<tr>
<td>100%</td>
<td>SD 1:2</td>
<td>21.95</td>
<td>12.92</td>
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<td>100%</td>
<td>GP</td>
<td>22.00</td>
<td>13.16</td>
</tr>
<tr>
<td>100%</td>
<td>D 1:1</td>
<td>23.50</td>
<td>13.67</td>
</tr>
<tr>
<td>100%</td>
<td>D 1:2</td>
<td>21.11</td>
<td>12.64</td>
</tr>
<tr>
<td>100%</td>
<td>SD 1:1</td>
<td>23.31</td>
<td>13.66</td>
</tr>
<tr>
<td>100%</td>
<td>SD 1:2</td>
<td>20.93</td>
<td>12.49</td>
</tr>
<tr>
<td>10%</td>
<td>GP</td>
<td>15.35</td>
<td>9.62</td>
</tr>
<tr>
<td>10%</td>
<td>D 1:1</td>
<td>15.82</td>
<td>10.26</td>
</tr>
<tr>
<td>10%</td>
<td>D 1:2</td>
<td>11.80</td>
<td>7.11</td>
</tr>
<tr>
<td>10%</td>
<td>SD 1:1</td>
<td>16.62</td>
<td>10.18</td>
</tr>
<tr>
<td>10%</td>
<td>SD 1:2</td>
<td>11.82</td>
<td>8.03</td>
</tr>
</tbody>
</table>

Table (8): Average WUE for sorghum crop (dry weight kg/m³)

<table>
<thead>
<tr>
<th>WQ</th>
<th>D</th>
<th>GP</th>
<th>D1:1</th>
<th>D1:2</th>
<th>SD1:1</th>
<th>SD1:2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>D1</td>
<td>3.32</td>
<td>3.86</td>
<td>3.19</td>
<td>3.73</td>
<td>3.61</td>
</tr>
<tr>
<td></td>
<td>D2</td>
<td>3.55</td>
<td>4.18</td>
<td>3.68</td>
<td>3.97</td>
<td>3.99</td>
</tr>
<tr>
<td>Q2</td>
<td>D1</td>
<td>4.29</td>
<td>4.84</td>
<td>4.39</td>
<td>4.86</td>
<td>4.48</td>
</tr>
<tr>
<td></td>
<td>D2</td>
<td>4.23</td>
<td>5.1</td>
<td>4.54</td>
<td>5.12</td>
<td>4.62</td>
</tr>
<tr>
<td>Q3</td>
<td>D1</td>
<td>4.17</td>
<td>4.91</td>
<td>3.38</td>
<td>4.59</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>D2</td>
<td>3.6</td>
<td>4.28</td>
<td>3.17</td>
<td>4.38</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Data presented in Table (8) reveal that mean values of water use efficiency seemed to be dependent on quantity of the irrigation water, type of the irrigation system and soil water depletion percentage. Application of the irrigation water at 70% of ET resulted in higher values of WUE than the other applied quantities i.e. 100% and 50% of ET did wherein irrigation at 50% depletion of the available water resulted in higher values of WUE under the all used irrigation systems and all rates of the applied water except when irrigation water was applied at its lowest ratio i.e. 50% of ET. Also the irrigation system SD1:1 resulted in the highest mean values of WUE, as compared with the other studied systems. However the interaction between water applied at a rate of 70% of ET and 50% depletion of available water under D1:1 irrigation system seemed to be of the highest effect on average value of WUE.

**CONCLUSION**

The crop yield is significantly affected by both of applied water quantity and soil water depletion where it was found that decreasing quantity of the applied water significantly decreased crop yield. Contrary to that, crop yield increases by decreasing soil available water depletion. On the other hand, variation in irrigation water system did not significantly affect crop productivity.

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المختص العربي
خدمة الري وانتاجية السورام تحت ظروف الزعري الجيروبة
جهاد جمال عبد الله محمد阿拉伯
محمد يوسف الأنصاري
منصور عبد الله عواد
احمد محمد جابر

الري السطحي هو أكبر طرق الري المستخدمة لإعداد المحصول باختلافة العناصر الشتاء وشبة السوق. مع زيادة الاستقرار للسكان والحياة الفردية الذاتية ومع زيادة الري عند الأعدار فإن الري السطحي مما يجري على القوى المدفوع بالري السطحي نالفطة المياة وكمية المحصول بالاحتياجات الفعلية من المياه دون اعداد وذلك عند تفضيض المحصول عند رفع الري إلى النجاة تراكب الري السطحي في مزارح الصحراء خلال عامي 2007، 2008 حيث تم اختبار

٥ تقييات الري

GP
١. الري بالانتتایب الموز
٢. الري بالتنقية السطحي
٣. حطري لكل خط بث
D1:1
٤. حطري لكل خط بث
D1:2
٥. حطري إلى التحت السطحي
SD1:1
٦. حطري إلى التحت السطحي
SD1:2
٧. حطري لكل خط بث

مشر. ج. ا. إ. ج. ج. ، كان 2012

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أوضحت نتائج التحليل الإحصائي زيادة عالية المحسوبة في جميع المعايير موضع الدراسة بزيادة كمية مياه الري المضافة تم الحصول على أعلى قيم للوزن الخارج و هي 11.77، 1.01، 29.2، 33.6، 31.5، 61.5 عن المعالجات D1:1، SD1:1 على الترتيب وكذلك عند إضافة 100% من الرياح GP، D1:1، SD1:1 على الترتيب وكذلك عند إضافة 100% من الرياح المئوية عند استنفاد 30% من الرياح المئوية وكذلك خلال عام 2009 في حين أن أعلى قيم للوزن الخارج و هي 8.21، 8.23، 8.22، 0.8 طن/كانتم تم الحصول عليها باتباع المعالجات D1:1، SD1:1 تحت 100% من الرياح المئوية عند استنفاد 30% من الرياح المئوية وكذلك خلال عام 2007 كانت أعلى قيم للوزن الخارج هي 42.05، 41.85 طن/ كانتم وذلك للمعالجات D1:1، SD1:1 على الترتيب في حين أن أعلى قيم للوزن الخارج وهي 7.98، 6.84 طن/ كانتم تم التوصل إليها في ظل المعالجات D1:1، SD1:1 تحت 100% من الرياح المئوية عند استنفاد 30% من الرياح المئوية. كذلك أوضح الدراسة أن كفاءة استخدام الماء تقل بزيادة كمية الماء المضافة.

النهايات

كانت الدراسة تحت ثلاث كميات من الماء 100%، 75% و 50% من كمية الماء المحسوبة من ماء مزمن موثوق المعالج مع نسبة استنفاد 30% و 50% من الماء المزمن المعالج بمنطقة الجوزرز، وأظهرت النتائج أن

1- يتمثل نتائج المحصول معيونا بكل من كميات الماء ونسبة الاستنفاد، حيث أن نقص
كمية الماء يحدث نقص معيون في المحصول. على العكس من ذلك يزيد المحصول بنقص
نسبة الاستنفاد، في حين اختلاف نظم الري لم يكن له تأثير معيون على الناتج
المحلل

Misr. J. Ag. Eng., Jan 2012

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