TOMATO OPTIMUM YIELD AND NET RETURN AS AFFECTED BY IRRIGATION WATER AMOUNTS AND NITROGEN RATES UNDER DRIP IRRIGATION SYSTEM AT NORTHWEST DELTA, EGYPT
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ABSTRACT
Two field experiments were carried out at Wadi El-Natrun, El-Behera Governorate, during 2008 and 2009 seasons to study the optimum tomato yield and net return obtained by irrigation water amounts and nitrogen rates under drip irrigation system. Split plot design was used with four replicates. The main plots were assigned by four irrigation water amounts (100 %, 90 %, 80 % and 70 %) of evapotranspiration (ETc). The sub-plots were randomly assigned by four nitrogen rates (0 (N0), 150 (N1), 225 (N2) and 300(N3) kg N fed.1) as ammonium nitrate. The other recommended agriculture practices were done.

Four polynomial quadratic equations were established to show the following results:
1. The maximum and optimum N rates (Xmax and Xopt) were increased as irrigation water amounts decreased from 100 % of ETc to 90 % of ETc and decreased as irrigation water amounts decreased from 90 % to 80 and 70 % of ETc in the two seasons.
2. The maximum and optimum tomato yields (Ymax and Yopt) were decreased as irrigation water amounts decreased in the two seasons.
3. The highest maximum yield (44.359 ton fed.1), the optimum yield (44.260), the highest return value of N fertilizer (10933.5 L.E fed.1) and the highest net return of N fertilizer (9072.0 L.E fed.1) were obtained as irrigation water amount 100 % of ETc used in the two seasons.
4. The efficiencies of N rates (eX) were decreased as N rates increased from N0 to N1, N2, N3 and N4 respectively with different irrigation water amounts.
5. The average of efficiency (eX), the relative efficiency (EX), the efficiency of nitrogen fertilizer at optimum rate (eXopt) and the efficiency of soil nitrogen (eXs) were decreased as irrigation water amounts decreased.
6. The soil nitrogen content during plant growth (Xs) was decreased as irrigation water amounts decreased in the two seasons.
7. The contribution of soil N was decreased as irrigation water amounts decreased in the two seasons.
8. The contribution of N fertilizer was increased as N levels increased in the two seasons.

INTRODUCTION
Tomato is one of the most important vegetable crops grown in Egypt and many other countries in the world wide. It is used as salads or taken as fresh fruit desserts, also for culinary cooking and many industrial process. It is considered as the first source of ten vitamins and minerals in human diet (Rick, 1978).
Optimum soil moisture content plays an important role in yield production. Plant growth and fruit yield will be reduced under high deficit of the available soil moisture especially in vegetative growth. El-Atawy (2007) and Meshref et al., (2008) indicated that the highest value of tomato total fruit yield was obtained from tomato plants irrigated at 1.3 evaporation pan coefficient compared to irrigated at 1.0 and 0.7 evaporation pan coefficient.

Nitrogen fertilization is very important for plant growth. Increasing nitrogen fertilizer levels up to 200 kg N fed.\(^{-1}\) increased tomato total yield (Abd El-Rahman, 2001). While, El-Shobaky (2002) found that nitrogen fertilizer applied at the rate of 300 kg N fed.\(^{-1}\) increased number of fruits plant\(^{-1}\) and fruit yield feddan\(^{-1}\). Meshref et al., (2008) indicated that the highest values of total fruit yield, water use efficiency and (NPK) concentrations were obtained from tomato plants fertilized with 320 kg N fed.\(^{-1}\). Arafa et al., (2009) indicated that there was a positive proportional trend with the applied nutrient amounts and the NPK residues in the fruits under the investigated irrigation systems. Zhang et al., (2010) indicated that fertilizer N application affected biomass yield, total and marketable fruit yields and N use efficiency, also, they found that nitrogen use efficiency decreased with increases in fertilizer N rate.

The excessive use of nitrogen fertilizers represents the major cost of crop production and creates pollution of agroecosystem Fisher and Richter (1984 ). Therefore many investigators have given more attention to the quantitative expression of the response of crops to fertilizer application based on changes in cultural practices. This would then enable us to calculate the optimum rate of fertilizer application on which is of economical importance. The expected yield when this optimum rate is applied and the obtainable yield at specified rate of fertilizer application can also be predicted Thabet and Balba (1994) , El Shebiny and Badr ,(1998) , Atia (2005), Atia et al. (2007) and Atia et al. ( 2009). were used the polynomial quadratic equations to calculate the net return from optimum rates of nitrogen applied and the contribution of soil and fertilizer nutrients to the yield.

The objectives of the present study were to assess the influence of nitrogen rates on tomato yield under different irrigation water amounts and the net return from these treatments

**MATERIALS AND METHODS**

Two field experiments were carried out during 2008 and 2009 growing seasons at Wadi El- Natrun, (30° 25’ N latitude and 30° 20’ E longitude), El-Behera governorate to study the effect of irrigation water amounts and nitrogen rates, on tomato optimum yield and the net return from the studied treatments. The experimental field was fertilized by 10 m\(^2\) of chicken manure as well as 15 kg P\(_2\)O\(_5\) fed.\(^{-1}\) (P\(_2\)O\(_5\) = 1.29 \times P) under tomatoes rows through soil preparation. The chicken manure contains 3.2% N, 2.1% P and 1.3% K.

Some physical and chemical properties of the experimental soils were determined according to the methods described by Page et al., (1984) and presented in Table 1.
Table 1: Some physical and chemical properties of the experimental soils.

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Sand %</th>
<th>Silt %</th>
<th>Clay %</th>
<th>Texture</th>
<th>*EC dSm⁻¹</th>
<th>**pH</th>
<th>O.M%</th>
<th>CaCO₃ %</th>
<th>Available nutrients Mg kg⁻¹ soil</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>74.4</td>
<td>13.65</td>
<td>11.95</td>
<td>sandy loam</td>
<td>0.67</td>
<td>7.4</td>
<td>0.92</td>
<td>12.9</td>
<td></td>
<td>28</td>
<td>7.0</td>
<td>377</td>
</tr>
<tr>
<td>2009</td>
<td>74.5</td>
<td>13.70</td>
<td>11.80</td>
<td>sandy loam</td>
<td>0.69</td>
<td>7.6</td>
<td>0.99</td>
<td>13.1</td>
<td></td>
<td>27</td>
<td>6.0</td>
<td>380</td>
</tr>
</tbody>
</table>

*: 1:5 Soil : Water extract
**: 1: 2.5 Soil : Water suspension

Surface drip irrigation system used was consisted of normal polyethylene pipes of 16 mm diameter as laterals with line dripper of 4 L/h at 50 cm apart. The laterals were located 150 cm apart, one lateral for each plant row. Irrigation water was filtered through gravel filters and refiltered through screen filters. The electrical conductivity of irrigation water was 1.1 dSm⁻¹. The treatments were arranged in a split plot design with four replicates. The main plots were assigned with four irrigation water amounts and the sub plots were randomly assigned with four N-fertilizer rates. The experiment size was 0.91 feddan included 64 rows with 150 cm apart and 40 m long.

Irrigation treatments were daily applied with amounts of water equal to 100%, 90%, 80% and 70% of the crop evapotranspiration (ETc). Nitrogen was applied as ammonium nitrate (33.5%N) at the rate of 0.0 (control), 150, 225 and 300 kg N fed.¹ through the irrigation water using venture injection in ten equal doses, the first dose after 5 days from transplanting, while the latter doses were applied on weekly basis.

Tomato seedlings (Lycopersicon esculentum mill. cv. Petopride) were transplanted in hills (single plant) of 50 cm apart at 11 and 18 of June during the two successive seasons 2008 and 2009. All field practices were done as usually recommended for tomato cultivation. Harvesting was done after 90 days from transplanting. Central area of 45 m² in each plot was kept for determining tomato yield to eliminate any border effect.

Statistical analysis:
All the data were statistically analyzed following the procedure outlined by Snedecor and Cochran (1980). Combined analysis conducted for the data of the two growing seasons according to Cochran and Cox (1957).

Quantitative analysis
The quadratic polynomial equation has been used to describe the tomato yield response to nitrogen rates, its general form is:

\[ Y = B_0 + B_1 X_i + B_2 X_i^2 \]

Where, the term, \( Y \) is the yield corresponding to nutrient rates \( X_i \). The term \( B_0 \) is the intercept, and \( B_1 \) and \( B_2 \) are the linear and quadratic coefficients, respectively. The constants \( B_0, B_1 \) and \( B_2 \) were calculated using the least squares method.
The maximum addition of fertilizer \( X_{\text{max}} \), the maximum yield \( Y_{\text{max}} \), the optimum rate of fertilizer \( X_{\text{opt}} \), the optimum yield \( Y_{\text{opt}} \). The efficiencies of N rates \( N_0, N_1, N_2, N_3 \) and \( N_4 \) \( (eX) \), the average of efficiency \( (\overline{eX}) \) of the fertilizer application rate \( (X) \) along the range from \( X= 0 \) to \( X= i \), the efficiency of fertilizer at optimum rate \( (eX_{\text{opt}}) \), the relative efficiency \( (EX) \), the efficiency of soil nitrogen \( (eX_s) \) and the soil nitrogen content \( X_s \) can be calculated from the following equations, respectively.

1. \[ X_{\text{max}} = - \frac{B_1}{2B_2} \] Balba (1961)

2. \[ Y_{\text{max}} = B_0 - \frac{B_1^2}{4B_2} \] Capurro and Voss (1981)

3. \[ X_{\text{opt}} = \frac{P_r - B_1}{2B_2} \] Balba (1964)

4. \[ Y_{\text{opt}} = B_0 + \frac{P_r^2 - B_1^2}{4B_2} \] Balba (1964)

Where the \( (Pr) = \frac{\text{Price of fertilizer unit}}{\text{Price of one ton of crop}} \)

5. \[ \overline{eX} = B_1 + B_2 X \text{ at } X_i = 3 \text{ units} \] Thabet and Balba (1994).

6. \[ eX = B_1 + 2 B_2 X \] Thabet and Balba (1994)

7. \[ eX_{\text{opt}} = B_1 + B_2 X_{\text{opt}} \text{ at } X = \text{optimum rate} \] Hassanein and El-Shebiny (2000)

8. \[ eX_s = B_0 \] Thabet and Balba (1994)

9. \[ EX = 0.1 \left( \frac{B_1^2 - 4B_0 B_2}{\text{at } y = 0} \right) \] Capurro and Voss (1981)

10. \[ X_s = \frac{-B \pm \sqrt{B_1^2 - 4B_0 B_2}}{2B_2} \] at \( y = 0 \)

11. \[ SE = \sqrt{(\text{Observed} - \text{Calculated})^2} \] \( \frac{1}{n-2} \)

12. The contribution of soil N = \( \frac{X_s}{X_f + X_s} \) x calculated yield
13. The contribution of fertilizer = \( \frac{X_f}{X_f + X_s} \) x calculated yield

RESULTS AND DISCUSSION

In the present study tomato yields were increased successively and significantly with N increments. The polynomial quadratic equations were established to express the tomato response to N application are presented in Table 2.

Table 2: The polynomial equations expressing tomato yield and irrigation water amounts of seasons (2008-2009)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>The polynomial equations</th>
<th>( R^2 )</th>
<th>( X_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 % of ETc</td>
<td>( Y = 23.393 + 9.670 X - 1.115 X^2 )</td>
<td>0.9993</td>
<td>1.971</td>
</tr>
<tr>
<td>90% of ETc</td>
<td>( Y = 22.831 + 9.121 X - 1.036 X^2 )</td>
<td>0.9994</td>
<td>2.033</td>
</tr>
<tr>
<td>80 % of ETc</td>
<td>( Y = 21.737 + 8.818 X - 1.023 X^2 )</td>
<td>0.9989</td>
<td>2.001</td>
</tr>
<tr>
<td>70 % of ETc</td>
<td>( Y = 20.233 + 3.836 X - 0.971 X^2 )</td>
<td>0.9989</td>
<td>1.968</td>
</tr>
</tbody>
</table>

The experimental and calculated tomato yields values obtained from the polynomial equations 1-4 are presented in Table 3. The calculated yields closely approximate experimental yield as shown from the values of standard error (SE) of estimates and determination coefficient (\( R^2 \)). The chi square test showed that the calculated yield values from each equations do not significantly differ from the experimental values for each treatment (Table 3).

Table 3: Observed and calculated tomato yield (ton fed.\(^{-1}\)) affected by irrigation water amounts and nitrogen fertilizer rates of seasons (2008 and 2009)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>100% of ETc</th>
<th>90% of ETc</th>
<th>80% of ETc</th>
<th>70% of ETc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>observed</td>
<td>calculated</td>
<td>observed</td>
<td>calculated</td>
</tr>
<tr>
<td>N(_0)</td>
<td>23.351</td>
<td>23.393</td>
<td>22.794</td>
<td>22.831</td>
</tr>
<tr>
<td>N(_1)</td>
<td></td>
<td></td>
<td>31.949</td>
<td>30.917</td>
</tr>
<tr>
<td>N(_2)</td>
<td>38.530</td>
<td>38.275</td>
<td>35.707</td>
<td>35.283</td>
</tr>
<tr>
<td>N(_3)</td>
<td>42.032</td>
<td>42.372</td>
<td>40.573</td>
<td>40.872</td>
</tr>
<tr>
<td></td>
<td>44.367</td>
<td>44.240</td>
<td>42.853</td>
<td>42.741</td>
</tr>
<tr>
<td>SE</td>
<td>0.237</td>
<td>0.227</td>
<td>0.290</td>
<td>0.271</td>
</tr>
</tbody>
</table>

Maximum and optimum N rates:

The values of maximum and optimum N rates for each treatment were calculated and presented in Table 4. The maximum and optimum N rates (\( X_{max} \) and \( X_{opt} \)) are the values of fertilizer required to give the maximum and optimum yields (\( Y_{max} \) and \( Y_{opt} \)). The maximum N rates (\( X_{max} \)) increased
from 4.336 unit N fed to 4.402 unit N fed as irrigation water amounts decreased from 100 % of ETc to 90 % of ETc as the mean of the two seasons and decreased to 4.310 and 4.309 unit N fed as irrigation water amounts decreased to 80 % and 70 % of ETc respectively. The values of the optimum N rates (Xopt) also show the same trend, where it increased from 4.034 unit N fed to 4.076 unit N fed as irrigation water amounts decreased from 100 % of ETc to 90 % of ETc as the mean of the two seasons and decreased to 4.000 and 3.961 unit N fed as irrigation water amounts decreased to 80 % and 70 % of ETc respectively. On the other hand, the values of Xopt were less than the values of Xmax whereas the Xopt were calculated by differentiating (y) in the polynomial equations from 1- 4 with regard to “X” “dy/dx” and equating with the ratio ( Pr ) of the price of fertilizer unit and the price of tomato unit ( ton ). The increase of Xmax and Xopt added may be attributed to two reasons. The first is the effect of irrigation water amounts on decomposition of chicken manure. The second is the decrease of fertilizer efficiency at optimum rate ( eXopt ) where it decreased from 5.172 ton unit fed to 4.522 ton unit fed as irrigation water amounts decreased from 100 % of ETc to 70 % of ETc (Table 5). This could be supported with those obtained by , Atia , et al (2010).

**Maximum and optimum yields:**

Data presented in Table 4 show that the Ymax was decreased as irrigation water amounts decreased from 100 % of ETc to 70 % of ETc, where Ymax decreased from 44.359 ton fed as the average of the two seasons. The highest Ymax value (44.359 ton fed.) was obtained when 100 % of ETc was used. The decrease of Ymax was more than 13.7 % as 70 % of ETc used. This difference between 100 % of ETc and 70 % of ETc values reflect the importance of irrigation water amounts to plant growth and nutrients uptake. These results are encouraged by those reported by Akmet et al. (2006) , Bao-Zhong et al.(2006) and Ayotamuno et al. (2007) .

As shown in Table 4 the values of Yopt were less than the values of Ymax where the values of Yopt were obtained by substitution of “X” by corresponding values of Xopt in equations 1-4 found in Table 2. The values of Yopt show the same trend of Ym, where it decreased from 44.26 ton fed to 38.144 ton fed as ETc decreased from 100 % ETc to 70 % of ETc (Table 4).

**The returns from applied optimum N rates**

The returns from applied optimum N rates are found in Table 4. The total values of the yield decreased from 22130 L.E fed to 19072 L.E fed as irrigation water amounts decreased from 100 % of ETc to 70 % of ETc. This decrease was more than 13.8 % of the returns from applied optimum N rates as 100 % of ETc used. Data in Table 4 also show the returns of N fertilizer and the returns per each Egyptian pound (L.E) spent for each of the applied optimum rate of N fertilizer. The highest value of L.E/ 1 L.E was 6.66 when 100% of ETc applied and the lowest one was 5.70 as 70 % of ETc used. Also the fertilizer / control ratio decreased as ETc decreased from 100 % of ETc to 70 % of ETc (Table 4). These could be enhanced with those obtained by El- Hady and Wanas (2006) and El- Atawy (2007).
Table 4: The maximum N rate \((X_m)\), optimum N rate \((X_{opt})\), maximum yield \((Y_m)\), optimum yield \((Y_{opt})\) and the returns of tomato under irrigation water amounts.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100% ETc</td>
<td>4.336</td>
<td>4.034</td>
<td>44.369</td>
<td>44.360</td>
<td>22130</td>
<td>116966.5</td>
<td>10433.5</td>
<td>1361.5</td>
<td>9072.0</td>
<td>6.66</td>
</tr>
<tr>
<td>90% ETc</td>
<td>4.402</td>
<td>4.076</td>
<td>42.986</td>
<td>42.796</td>
<td>21396</td>
<td>114155.5</td>
<td>9982.5</td>
<td>1375.6</td>
<td>8606.5</td>
<td>6.26</td>
</tr>
<tr>
<td>80% ETc</td>
<td>4.310</td>
<td>4.000</td>
<td>40.799</td>
<td>40.628</td>
<td>20314</td>
<td>108688.5</td>
<td>9446.5</td>
<td>1350.0</td>
<td>8095.5</td>
<td>6.00</td>
</tr>
<tr>
<td>70% ETc</td>
<td>4.309</td>
<td>3.961</td>
<td>38.262</td>
<td>38.144</td>
<td>19072</td>
<td>101165.5</td>
<td>8955.5</td>
<td>1336.8</td>
<td>7618.7</td>
<td>5.70</td>
</tr>
</tbody>
</table>

Price of tomato = 500 L.E. ton\(^{-1}\)
Fertilizer price = 337.5 L.E. unit\(^{-1}\)
Fertilizer unit = 75 kg

Efficiencies of nitrogen fertilizer and soil nitrogen:

The efficiencies of N rates \((N_0, N_1, N_2, N_3\) and \(N_4)\), the average efficiencies \((eX)\), the relative efficiency \(EX\), the efficiency of optimum N rate \((eX_{opt})\) and the efficiency of soil nitrogen \((eX_s)\) are presented in Table 5. The efficiencies of N rates \((eX)\) decreased as N rates increased from \(N_0\) to \(N_4\) under the different irrigation water amounts \((ETc)\) used. It can be stated that the \(eX\) values change from a maximum at the beginning at \(N_0\) and decrease till it reach zero at the maximum yield and turn to negative at further increments. The values of \(eX\) decreased from 9.670 ton unit\(^{-1}\) fed.\(^{-1}\) to 7.440, 5.210, 2.980 and 0.750 ton unit\(^{-1}\) fed.\(^{-1}\) as N rates increased from \(N_0\) to \(N_1, N_2, N_3\) and \(N_4\) respectively as 100% of \(ETc\) used. The values of \(EX, eX_{opt}\) and \(eX_s\) decreased as irrigation water amounts decreased from 100% of \(ETc\) to 90%, 80% and 70% of \(ETc\) respectively. The values of \(EX\) decreased from 1.407 ton unit\(^{-1}\) fed.\(^{-1}\) to 1.333, 1.291 and 1.219 ton unit\(^{-1}\) fed.\(^{-1}\) as irrigation water amounts decreased from 100% of \(ETc\) to 90%, 80% and 70% of \(ETc\) respectively.

It is clearly from mentioned results that the different efficiencies of fertilizer (Table 5) decreased as irrigation water amounts decreased. These results reflect the effect of irrigation water amount on plant growth where the increase of it increase the surface area per unit root length and enhanced root hair branching with an eventual increase in the uptake of nutrients from the soil and vice versa. The results are in agreement with those obtained by Thabet and Balba (1994), Atia (2005), Atia, et al. (2007) and Atia, et al. (2009) who stated that the efficiency of nitrogen fertilizer had decreased with increasing levels of N fertilizer.
Table 5: Efficiencies of N rates (eX), (cX), EX, eXopt and eXs under irrigation water amounts.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>eX (ton unit⁻¹ fed⁻¹)</th>
<th>cX</th>
<th>EX</th>
<th>eXopt</th>
<th>eXs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N₀</td>
<td>N₁</td>
<td>N₂</td>
<td>N₃</td>
<td>N₄</td>
</tr>
<tr>
<td>100% ETc</td>
<td>9.670</td>
<td>7.440</td>
<td>5.210</td>
<td>2.980</td>
<td>0.750</td>
</tr>
<tr>
<td>90% ETc</td>
<td>9.121</td>
<td>7.049</td>
<td>4.977</td>
<td>2.905</td>
<td>0.833</td>
</tr>
<tr>
<td>80% ETc</td>
<td>8.818</td>
<td>6.772</td>
<td>4.726</td>
<td>2.680</td>
<td>0.634</td>
</tr>
<tr>
<td>70% ETc</td>
<td>8.368</td>
<td>6.426</td>
<td>4.484</td>
<td>2.542</td>
<td>0.600</td>
</tr>
</tbody>
</table>

Contribution of soil and fertilizer N to yield:
In fact, the roots absorb the plant needs of N from two available sources of N, the soil source and the fertilizer source. Accordingly, the contribution of the soil source in yield would be equal to \( \frac{X_s}{X_f + X_s} \) multiplied by calculated yield, and the contribution of fertilizer source = \( \frac{X_f}{X_f + X_s} \) multiplied by calculated yield.

The results presented in Table 6 show that the contribution of N fertilizer increased as N rates increased from N₀ to N₁, N₂, N₃ and N₄ with the different irrigation water amounts. For example the values of 100 % ETc increased from 0.0 to 10.767, 19.291, 25.593 and 29.641 ton fed⁻¹ respectively. On contrast, the contribution of soil N decreased as N rates increased from N₀ to N₁, N₂, N₃ and N₄, respectively. Other irrigation water amounts show the same trend (Table 6). Thabet and Balba (1994), Atia, et al. (2007) and Atia et al. (2009) obtained similar results, where they stated that the contribution of N fertilizer to the crop yields increased with the increase of fertilizer N application and the contribution of soil N to the crop yields decreased with the increase in the fertilizer N application.

Table 6: Contribution of soil N and added fertilizer to tomato yield at different irrigation water amounts as average of two seasons (2008, 2009)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>100% of ETc</th>
<th>90% of ETc</th>
<th>80% of ETc</th>
<th>70% of ETc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soil N⁻¹ ton fed⁻¹</td>
<td>Fert. N⁻¹ ton fed⁻¹</td>
<td>Soil N⁻¹ ton fed⁻¹</td>
<td>Fert. N⁻¹ ton fed⁻¹</td>
</tr>
</tbody>
</table>

Data presented in Table 7 show that the contribution fraction of N fertilizer increased as N rates increased where it increased from 0.00 to
0.337, 0.504, 0.604 and 0.670 as N fertilizer increased from N_0 to N_1, N_2, N_3 and N_4 as 100% of ETc used. The other irrigation water amounts (90 % of ETc, 80 % of ETc and 70 % of ETc) gave the same trend. The contribution fraction of soil N deceased with increasing N rates. The values of contribution fraction of soil N decreased from 1.0 to 0.663, 0.496, 0.396 and 0.330 as N rates increased from N_0 to N_1, N_2, N_3 and N_4, respectively with 100 % ETc. The same trend observed as other irrigation water amounts used.

Table 7: Contribution fraction of soil N and added fertilizer to tomato yield at different irrigation water amount as average of two seasons (2008 & 2009).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>100% of ETc</th>
<th>90% of ETc</th>
<th>80% of ETc</th>
<th>70% of ETc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil N (^\text{ton fed.})</td>
<td>Fert. N (^\text{ton fed.})</td>
<td>Soil N (^\text{ton fed.})</td>
<td>Fert. N (^\text{ton fed.})</td>
<td>Soil N (^\text{ton fed.})</td>
</tr>
<tr>
<td>N_0</td>
<td>1.000</td>
<td>0.000</td>
<td>1.000</td>
<td>0.000</td>
</tr>
<tr>
<td>N_1</td>
<td>0.663</td>
<td>0.033</td>
<td>0.670</td>
<td>0.030</td>
</tr>
<tr>
<td>N_2</td>
<td>0.496</td>
<td>0.504</td>
<td>0.504</td>
<td>0.496</td>
</tr>
<tr>
<td>N_3</td>
<td>0.396</td>
<td>0.604</td>
<td>0.404</td>
<td>0.596</td>
</tr>
<tr>
<td>N_4</td>
<td>0.330</td>
<td>0.670</td>
<td>0.337</td>
<td>0.663</td>
</tr>
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</table>

REFERENCES


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محصول الطماطم الأمثل والعائد الاقتصادي من كميات مياه الري ومعدلات التسميد النتروجيني تحت نظام الري بالتنقيط في شمال غرب الدلتا بمصر

جب حجازي عطية، الخالى الشبرى الطوطي، عاطف صبحى محمود السعدي
متحده بحوث الأراضي والمياه والبيئة - مركز البحوث الزراعية - الجيزة - مصر

أقيمت تحديدا حقيقية خلال موسم 2008/2009 بمنطقة وادي النطمرون في محافظة الجيزة، وذلك بهدف دراسة المحصول الزراعي من كميات مياه الري ومعدلات التسميد النتروجيني تحت نظام الري بالتنقيط.

النتائج النهائية:

1. العوامل الرئيسية:
- الرياضياتية: الماء يومياً، بتعبير 100% من جهد البخار، وتحت الأبعاد متوسطة يومياً، بتعبير 90% من جهد البخار.
- الرياضياتية: الماء يومياً، بتعبير 80% من جهد البخار.
- الرياضياتية: الماء يومياً، بتعبير 70% من جهد البخار.

2. النتائج النهائية:
- كانت النتائج النهائية ارتفاع محصول الطماطم تتراوح بين 443359 و 443860 طن/нем.
- كانت النتائج النهائية ارتفاع المحصول الاقتصادي تتراوح بين 0043335 و 907830 جنية مصري.

3. استنتاجات:
- تناقصت عائدات السماد والمصروفيات من الري بكميات الري المختزلة.
- تناقصت تركيز السماد الكلية في الأرض مع تناقص كميات الماء المضافة في المواسم.
- تناقصت تركيز السماد الكلية في الأرض مع تناقص كميات الماء المضافة في المواسم.
- تناقصت تركيز السماد الكلية في الأرض مع تناقص كميات الماء المضافة في المواسم.
- تناقصت تركيز السماد الكلية في الأرض مع تناقص كميات الماء المضافة في المواسم.

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