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WATER AND FERTILIZER REQUIREMENTS FOR TOMATO CROP UNDER TRICKLE AND SPRINKLER IRRIGATION SYSTEMS IN SANDY SOILS

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ABSTRACT

Field experiments were conducted during the growing season of 2006 at the Desert Farm of the Faculty of Agriculture, Ain Shams University, EL-Bustan Region, Beheira Governorate that presents sandy soil conditions, to determine the water and fertilizer requirements for tomato crop. Tomato transplanting (Castle Rock variety) was planted under trickle and sprinkler irrigation systems. Also, nitrogen fertilizers (Ammonium nitrate, 33%N) were applied through trickle and sprinkler irrigation systems with three rates (50, 75 and 100 kg-N/fed).

The results of this experiment revealed that

1- Irrigation efficiency under trickle irrigation (84.16%) was higher than that under sprinkler irrigation system (66.32%) by 17.84%.
2- Seasonal irrigation water requirements for tomato crop based on the climatic data (2439.9 and 2832.8 m^3/fed) was higher than estimated values using the soil samples method (1886 and 2153.1 m^3/fed) by 16.1% and 14.1% under both trickle and sprinkler irrigation systems respectively.
3- Highest yield was obtained (8.61 ton/fed) when using trickle irrigation compared to sprinkler irrigation (7.10 ton/fed) by an increase of 21.2%.
4- Water use efficiency under surface trickle irrigation was (3.53 kg/m^3) higher than that under sprinkler irrigation systems (2.51 kg/m^3) by 40.6%.
5- There was no significant effect to irrigation method on the plant height, and number of branches/ plant, but there was an effect to irrigation method on No. of fruits/plant.
6- Tomato yield increased by 202% and 172% with increasing fertilization rate from 50 to 100 kg-N/fed under both trickle and sprinkler irrigation systems respectively.
7- The lowest cost of tomato production unit was 89.3 and 104 LE/ton under trickle and sprinkler irrigation systems respectively at fertilization rate of 100 kg-N/fed, while the highest cost of tomato production unit was 231.3 and 222.3 LE/ton under sprinkler and trickle irrigation systems at fertilization rate of 50 kg-N/fed.
8- The difference in the cost of tomato production unit, when applying 75 and 100 kg-N/fed with trickle irrigation system, was small.

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INTRODUCTION

Tomato is the major vegetable crop in Egypt. The annual cultivated area is estimated to be 110657feddans amounting to 38.5% of the total vegetable area, which annually produces over 1.149million tons yearly according to **Agricultural Statistics, (2005).**

Water becomes most economical scarce resource in many areas of the world, especially in arid and semi- arid regions. However, water is a limiting factor in agriculture expansion depending on its quantity, quality and method of application. Estimating irrigation water requirements becomes more important for project planning and management of irrigation. Pressurized irrigation systems have been used for irrigating vegetables and other crops for high water and agro-chemicals use efficiencies, to facilitate planting newly reclaimed areas with limited water sources in the desert without environmental problem, hazard and impact (**Bianchi *et al* 1985 and Chase, 1985**).

Abdel Maksoud (1992) conducted a study on selecting the proper system of tomato irrigation in new lands and reported that the highest level of moisture content was obtained through a depth of (0-30cm) under trickle irrigation system comparing to sprinkler and furrow irrigation systems. The highest yield was obtained under trickle irrigation system. **Smith and Watts (1986)** Field evaluation of irrigation systems performance is essential to improve irrigation management. Volumetric water control and distribution uniformity in irrigation system are essential factors in achieving accurate water applications. **Arnaout (1995)** stated that the efficiency of any irrigation system depends on water supply in the desired time. The average irrigation efficiency of the trickle irrigation increased by about 15.87% and 38.37% more than irrigation efficiency of sprinkler and furrow irrigation systems respectively. **El-Gindy and Abdel-Aziz (2003)** found that the highest grain yield (4.24Mgram/fed) was produced under trickle irrigation system compared to sprinkler irrigation system (3.36 Mgram/fed) in sandy soils. **Khalifa (2005)** found that microirrigation tended to increase grain yield of pea by 9.7% over trickle irrigation because microirrigation wetted a large area around the plants and reduces the leaf diseases compared to the trickle irrigation system under sandy soil conditions. **Khalifa (2006)** found that the average cotton yield values were 4.89, 5.69 and 4.93 kentar/fed. For traditional furrow, alternative furrow and trickle irrigation system respectively. Also, the maximum value of water use efficiency was 0.43kg/m^3 using trickle irrigation system while, the worst value was 0.21kg/m^3 obtained with traditional furrow irrigation.

Seleman (1993) said that the fertigation is the application of nutrients through an irrigation system (by introducing the nutrients into the water flowing through the system). Through this method fertilizer added at a time when the crops need it with amounts required at different growing stages and at the suitable position for the highest uptake of nutrients by the roots. Therefore, fertigation adds a new dimension to irrigation system. It becomes a multifunction unit able to supply crops with the necessary water and agro-chemicals at the same time. **El-Gindy (1988)** found that yield of tomato and cucumber was higher for fertigation than broadcasting methods. The increase in yield was 37% for tomato under trickle fertigation and 22.2 and 53.2% for cucumber under sprinkler and trickle fertigation techniques, respectively. **Hamdy (1991)** found that applying nitrogen fertilizers using fertigation gave increase in tomato yield, which was nearly by 70% greater than that of the control (without fertilization) and the conventional nitrogen application treatments. This evidently, indicates that such a nitrogen concentration is below the level required to meet the tomato requirement of third element at different growing stages. **Goyal *et al* (1995)** reported that the yield of eggplant and peppers was high under fertigation comparing with traditional method. These increases in yield were 27.6 and 22.4% for eggplant and peppers crops, respectively. **Abdel-Aziz (1998)** found that injection the fertilizers through irrigation systems produced 23.41% more in potato yield than that the conventional method of fertilization. **Sallam and Abdalla (2002)** studied the effect of irrigation water stress and nitrogen levels on growth of common bean in sandy soil treated with tafla under sprinkler irrigation system. Their results indicated that increasing water amount and nitrogen levels caused a significant increase in the values of growth characters (plant height, plant fresh and dry weights), seed yield and protein content in seeds.

The objective of this study is to determine the water and fertilizer requirements for tomato crop under trickle and sprinkler irrigation systems in sandy soils.

MATERIALS AND METHODS

Experimental site

Field experiments carried out in the Desert Farm of the Faculty of Agriculture, Ain Shams University that presents sandy soil conditions, El-Bustan Region, Beheira Governorate. Experimental area was divided into two parts; the first part was equipped solid-set sprinkler irrigation system and it divided into 9 plots (12.5x18m for each) while, the second part was equipped surface trickle irrigation system and it divided into 9 plots (20x5m for each).

Some physical properties of soil and some chemical analysis of soil and irrigation water were conducted according to standard procedures (**Black, 1982**) and represented in **Tables (1, 2 and 3)**.

Table 1. Some physical properties of sandy soil

Sample depth	Particle Size Distribution %				F.C. %	W.P. %	B.D. g/cm^3	Texture Class
	C. Sand	F. Sand	Silt	Clay				
0-30	52.8	41.4	4.1	1.7	9.4	4.3	1.68	Sandy
30-60	50.0	43.5	5.0	1.5	8.5	4.4	1.57	Sandy

F.C. = Field capacity; W.P.= Welting point, F.C. and W.P. were determined as percentage in weight; B.D. = Bulk density; C.= Coarse and F. Fine sand.

Table 2. Some chemical analysis of sandy soil

Sample depth	pH 1.25	EC dS/m	Soluble Cations in meq/l				Soluble Anions meq/l			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO^{--}_3	HCO^{-}_3	SO^{--}_4	CL^{-}
0-30	8.2	1.27	2.9	2.8	5.1	0.6	-	3.6	2.0	6.1
30-60	8.3	1.22	2.9	2.1	5.2	0.7	-	3.7	2.1	6.3

Table 3. Some chemical analysis of irrigation water

pH	EC dS/m	Soluble Cations in meq/l				Soluble Anions meq/l			SAR
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_3	SO^{--}_4	CL^{-}	
7.74	1.02	1.03	0.74	8.01	0.42	1.95	4.52	3.73	8.51

Irrigation systems

Two irrigation systems installed in this experiment are sprinkler and trickle irrigation. These systems include the following components as shown in **Fig. (1)**:

1- Control head located at the water source and consists of electrical centrifugal pump ($50m^3/h$ discharge and 40m lift), media filter (2tanks 36" diameter), two screen filter 3" diameter of inlet and outlet (120mesh), flow meter and pressure gauges.
2- 125/110 mm outer diameter PVC, main line.
3- 75mm diameter PVC, sub main line
4- 40mm diameter PVC manifold line for sprinkler irrigation and 32mm in diameter for trickle irrigation.
5- Distributors:
   - Sprinklers are fixed at 12 x 12 m spacing (four sprinklers for each plot), they were 1.0 m^3/h discharge at 2.2 bar operating pressure for each and wetted diameter of 22m.
   - Line source emitters with discharge of 4 lph/50cm spacing at 1.0 bar operating pressure built-in PE laterals of 16 mm (OD) in diameter with 0.75 m spacing between lines and 20m length.

Irrigation requirement

1- Calculated irrigation water requirement

Water requirement for tomato crop was calculated as follows:

- Water consumptive use was calculated according to the climatic data recorded at El-Bustan Weather Station using the following formula **(Doorenbos and Pruitt, 1977).**

$$ET_{crop} = ET_0 \cdot K_c$$

Where

ET_{crop} = Crop water consumptive use, mm/day,
ET_0 = Reference evapotranspiration, mm/day, and
K_c = Crop coefficient, dimensionless.

A crop coefficient value for tomato crop was used according to the different growth stages of crop according to **FAO (1984)**. Values of Kc and water consumptive use for different growth stages are presented in **Table (4)**.

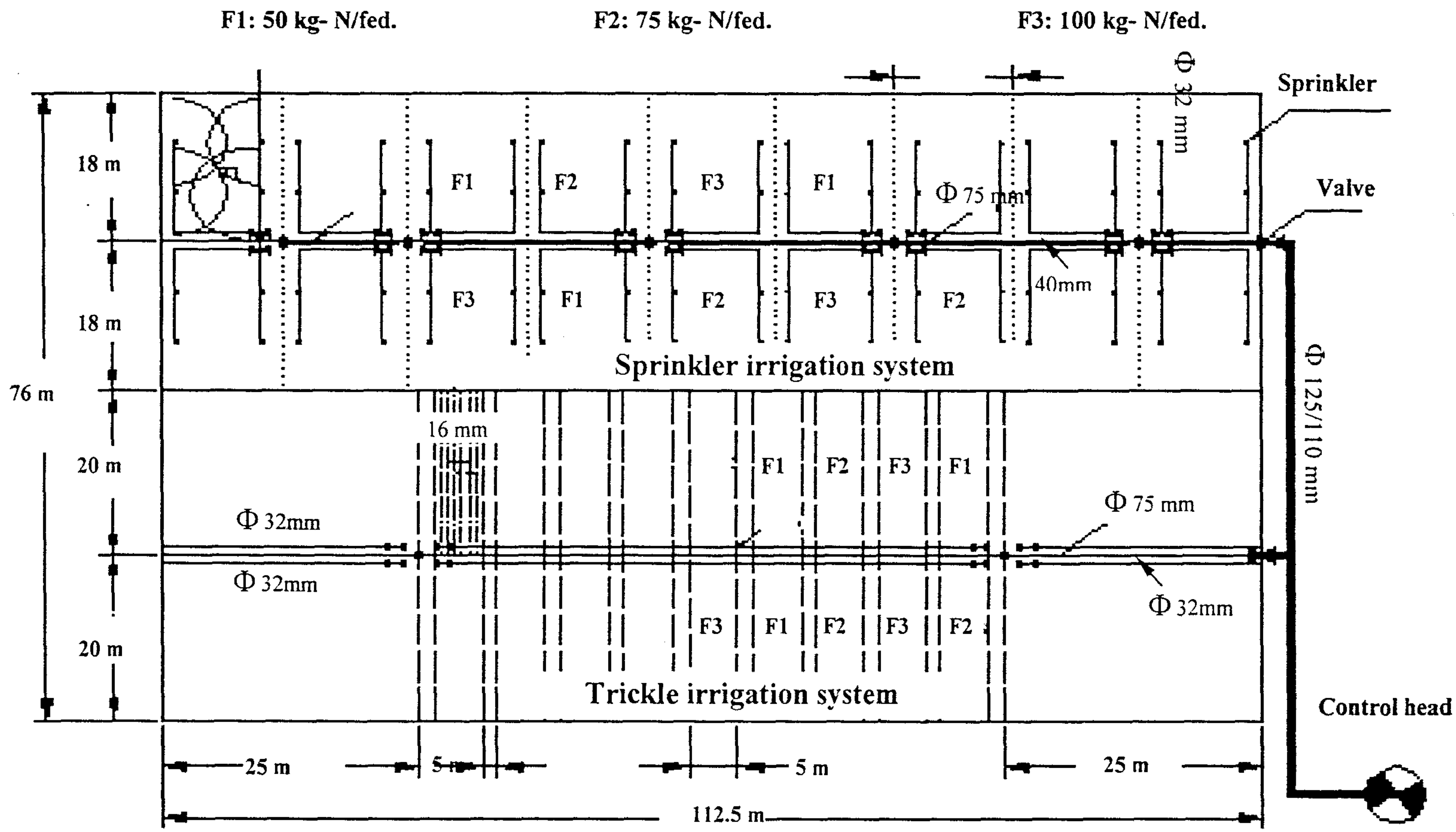

Fig.1: Layout of trickle and sprinkler irrigation systems.

Table 4. Calculated water consumptive use for tomato crop

Growth stages	ET_0 (mm/day)	K_C	ET_{Crop} (mm/day)	ET_{Crop} (mm//stage)
Initial				
10/5/2006-31/5/2006	5.44	0.70	3.81	80.01
1/6/2006-9/6/2006	5.91	0.70	4.14	37.26
Flowering & fruiting				
10/6/2006-30/6/2006	5.91	1.05	6.21	124.20
1/7/2006-25/7/2006	5.34	1.05	5.61	140.25
Harvesting				
26/7/2006-31/7/2006	5.34	0.80	4.27	21.35
1/8/2006-31/8/2006	4.91	0.80	3.93	121.83
1/9/2006-4/9/2006	4.80	0.80	3.84	15.36
Total ET_{crop} (mm/season	-	-	-	**540.26**

- Estimating of applied water requirements was calculated according to **Vermeiren and Jobling (1980).**

$$WR = (ET_{Crop} \times I \times 4.2) / E_a$$

Where

WR = applied irrigation requirement, m^3/fed/ Irrigation,
E_a = application efficiency, % and
I = irrigation intervals, days.

2- Actual irrigation water requirement

Actual irrigation water requirement was estimated based on the soil moisture content and calculated according to **James (1988).**

$$ET_{actual} = D\ (\theta_2 - \theta_1) \times 4.2$$

Where

ET_{actual} = actual water consumptive use, m^3/fed/ Irrigation,
θ_2 = soil moisture content by weight after irrigation, mm/m,
θ_1 = soil moisture content by weight before irrigation, mm/m, and
D = soil depth, m.

Soil samples were taken for estimating the actual water consumptive use from two depths (0-30cm) and (30-60cm) after 1 hour from irrigation and before the next irrigation throughout each growth stage.

Agricultural Practices

1- Soil-bed preparation by ploughing of the soil two times using chisel plow with added 10m^3 / fed. of fertilizer manure (Katkoat).
2- Addition of 250 kg/fed of superphosphate, 15.5% P_2O_5 during soil-bed preparation.
3- Soil planning (furrow every 0.75 m).
4- Tomato (Castle Rock variety) was transplanted on the 10th of May, 2006.

Treatments

The experiment was a split plot design, arranged in a randomized complete block with three replicates. Irrigation systems were assigned to main plots, while fertilization rates were assigned to subplots as shown in **Fig. (1)**.These treatments are:

1- Irrigation methods

- Sprinkler irrigation system.
- Trickle irrigation system.

2- Fertilization treatments

Nitrogen fertilizers were applied through irrigation systems with three rates are100, 75 and 50 kg-N/fed respectively, in form of ammonium nitrate, 33%N. These amounts of fertilizers were divided into 15 doses and applied injecting with irrigation water during the growing season.

Measurements and calculations

1- Irrigation systems evaluation

- Application efficiency of irrigation systems for 60 cm soil depth was calculated according to **James (1988)** as follows

$$E_a = \frac{E_{DZ}}{D_T} \times 100$$

Where

E_a = application efficiency, %,
E_{DZ} = depth of water stored in the root zone, cm, and
D_T = gross depth of applied water, cm

- Distribution uniformity of irrigation systems was calculated according to **Burt et al (1997)** as follows

$$D_u = \frac{D_{lq}}{D_{ac}} \times 100$$

Where

D_u = distribution uniformity, %,
D_{lq} = the water depth of infiltrated on the quarter of the area which received the lowest amount of the irrigation water, cm, and
D_{ac} = the average water depth of infiltrated, cm.

- Total irrigation efficiency was calculated according to **Wu and Gtilin (1975).**

$$E_i = E_a \times D_u$$

Where

E_i = total irrigation efficiency, %,
E_a = application efficiency, %, and
D_u = distribution uniformity, %.

2- Plant measurements

- plant height, cm.
- number of branches/plant
- number of fruits/ plant
- total yield, ton/fed.

3- Determine water use efficiency (WUE)

It was calculated according to the following equation:

$$WUE\ (kg/m^3) = \frac{Total\ yield\ (kg/fed)}{Total\ applied\ water\ (m^3/fed)}$$

4- Determine fertilizer use efficiency (FUE)

It was calculated according to the following equation:

$$FUE\ (kg/kg) = \frac{Total\ yield\ (kg/fed)}{Total\ applied\ nitrogen\ (kg/fed)}$$

5- Economical analysis

- **Irrigation costs**

Capital cost for different irrigation systems and chemical application were calculated using current dealer prices (2006) for equipment and installation according to **Worth and Xin, (1983)**.

- **Fertilization cost**

Fertilization of tomato crop was carried out by injecting the fertilizers through the irrigation system. Fertilization cost was calculated as follows

$$F_r = (W_f \times P_r) + A_c$$

Where

F_r = fertilization cost, LE/fed.
W_f = amount of fertilizers, kg/fed.
P_r = fertilizers price, LE/kg
A_c = application cost of fertilizers, LE/fed.

Fertigation costs = Irrigation cost + fertilizer injection cost

6- Production cost unit

It was calculated as follows

$$Production\ cost\ unit\ (LE/ton) = \frac{Total\ cost\ (LE/fed)}{Total\ yield\ (ton/fed)}$$

RESULTS AND DISCUSSION

1- Irrigation systems evaluation

Fig. (2) shows that the average irrigation water application efficiency of trickle irrigation reached up (93%) was higher than that under sprinkler irrigation system (80.1%) by 12.9%. This may be due to the least percentage of water loss occurred under trickle irrigation system, less water is lost resulting from direct evaporation and deep percolation. Meanwhile, the value of water distribution uniformity was 82.8% for sprinkler irrigation system decreased by 7.7% than the water distribution uniformity of the trickle irrigation system (90.5%). On the other hand, total irrigation efficiency under trickle irrigation (84.16%) was higher than that under sprinkler irrigation system (66.32%) by 17.84%.

2- Irrigation water requirement for tomato crop

Fig. (3) shows that the seasonal irrigation water requirements for tomato crop based on the climatic data was higher than estimated values using the soil samples method by 16.1% and 14.1% under both trickle and sprinkler irrigation systems respectively. Also, results indicated that the actual seasonal irrigation water requirements under sprinkler irrigation system (2153.1 m^3/fed) were higher than that under trickle irrigation system (1886 m^3/fed) by 14.1%. This may be due to the lower efficiency of sprinkler irrigation compared to the trickle irrigation system. These results are in agreement with **Arnaout (1997); El-Gindy and Abdel-Aziz (2003).**

3- Effect of irrigation system and fertilization rate on growth parameters, total yield, water and fertilizer use efficiencies

Data illustrated in **Figs. (4, 5 and 6)** indicated that there were no significant effects to irrigation system on the plant height, number of branches/ plant but there was an effect to irrigation method on number of fruits /plant.

Data illustrated in **Figs. (4, 5 and 6)** indicated that the plant height, number of branches/plant and number of fruits/plant increased were significantly by increasing fertilization rate from 50 to 100 kg-N/fed under both trickle and sprinkler irrigation system.

Fig. (7) shows that trickle irrigation system produced higher tomato yield compared to sprinkler irrigation system. In general, the highest yield of tomato was obtained when using trickle irrigation (8.61 ton/fed) by 21.2% compared to sprinkler irrigation (7.10 ton/fed). An increase in the yield under trickle irrigation may be attributed to the short irrigation in case of trickle irrigation, which lead to the moisture content of the top layer of soil to be higher in the trickle irrigation fields than under sprinkler irrigation **(El- Gindy, 1988).**

Fig. (7) indicates that the tomato yield increased by 202% and 172%. with increasing fertilization rate from 50 to 100 kg-N/fed under trickle and sprinkler irrigation system respectively. Total yield increased from 2.85 to 8.61 ton/fed with increasing fertilization rate from 50 to 100 kg-N/fed under trickle irrigation while, the yield increased from 2.61 to 7.10 ton/fed by increasing fertilization rate from 50 to 100 kg-N/fed under sprinkler irrigation system.

On the other hand, data illustrated in **Fig. (8)** indicated that the water use efficiency under trickle irrigation was (3.53 kg/m^3), higher than that under sprinkler irrigation system (2.51 kg/m^3) by 40.6%. This due to that trickle irrigation gives more concentrated wetted area around the roots of tomato plants than sprinkler irrigation system and consequently higher the water use efficiency under trickle irrigation system .

On the other hand, water use efficiency by tomato plants increased with increasing fertilization rate under both trickle and sprinkler irrigation systems as shown in **Fig. (8)**. The highest water use efficiency values were 3.53 kg/m^3 and 2.51 kg/m^3 under trickle and sprinkler at high fertilization rate (100 kg-N/fed), while, the lowest values of water use efficiency were 1.17 kg/m^3 and 0.92 kg/m^3 under trickle and sprinkler at low fertilization rate (50 kg-N/fed).

Fig. (9) shows that the fertilizer use efficiency under trickle irrigation (86.9 kg/kg-N) was higher than that under sprinkler irrigation system (71.0 kg/kg-N) by 18.3%. This is due to that high frequency application of nutrients under trickle irrigation allows splitting of the fertilizers amount, so that the elements availability is fitted to nutritional needs of the crop **(El- Gindy, 1988).**

Also, the fertilizer use efficiency increased with increasing fertilization rate under different irrigation systems as shown in **Fig. (9)**. The highest fertilizer use efficiency values were 86.9 kg/kg-N under trickle irrigation at fertilization rate (75 kg-N/fed) and 71 kg/kg-N under sprinkler irrigation at fertilization rate (100 kg-N/fed), while the lowest values of fertilizer use efficiency values were 57.0 kg/kg-N and 52.2 kg/kg-N under trickle and sprinkler at fertilization rate (50 kg-N/fed).

4- Cost analysis

Data presented in **Table (5)** indicate that the lowest production cost unit of tomato production unit was 89.3 and 104 LE/ton under trickle and sprinkler irrigation systems respectively at fertilization rate of 100 kg-N/fed, while the highest cost of tomato production unit was 231.3 and 222.3 LE/ton under sprinkler and trickle irrigation systems, respectively at fertilization rate of 50 kg-N/fed. On the other hand, results showed that the difference in the cost of tomato production unit when applying 75 and 100 kg-N/fed with trickle irrigation system was small.

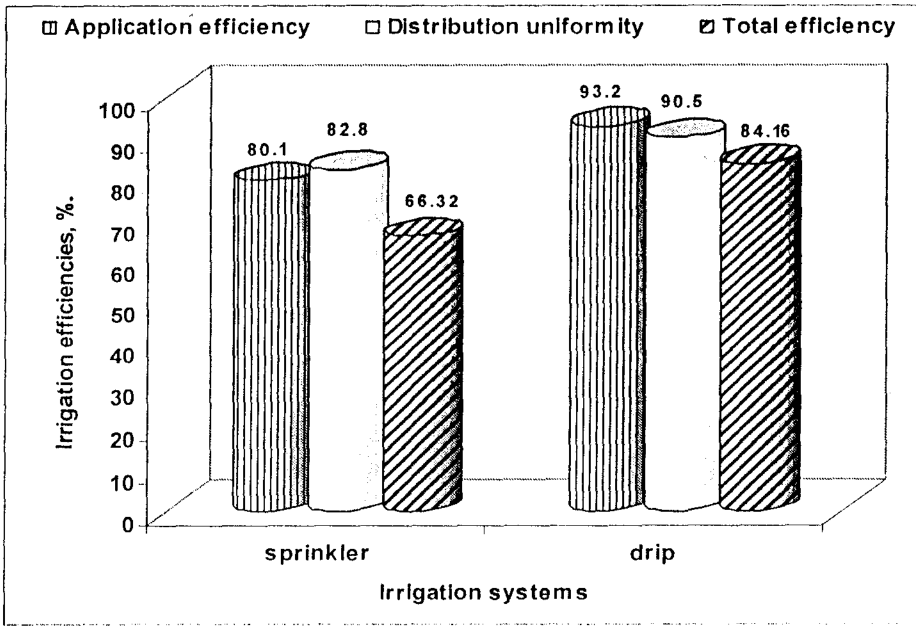

Fig. 2. Irrigation efficiencies for trickle and sprinkler systems

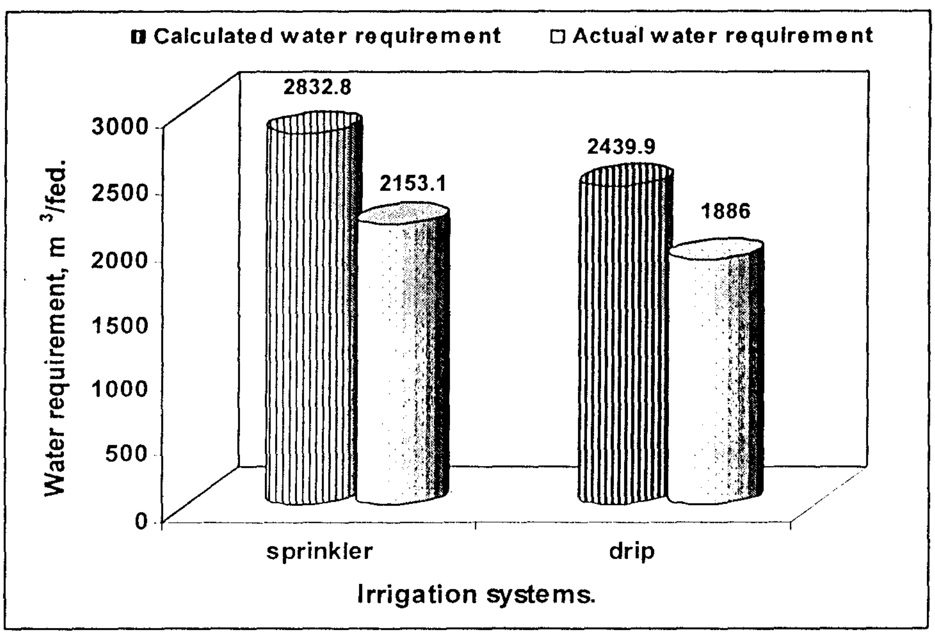

Fig. 3. Calculated and actual irrigation water requirements for trickle and sprinkler irrigation systems

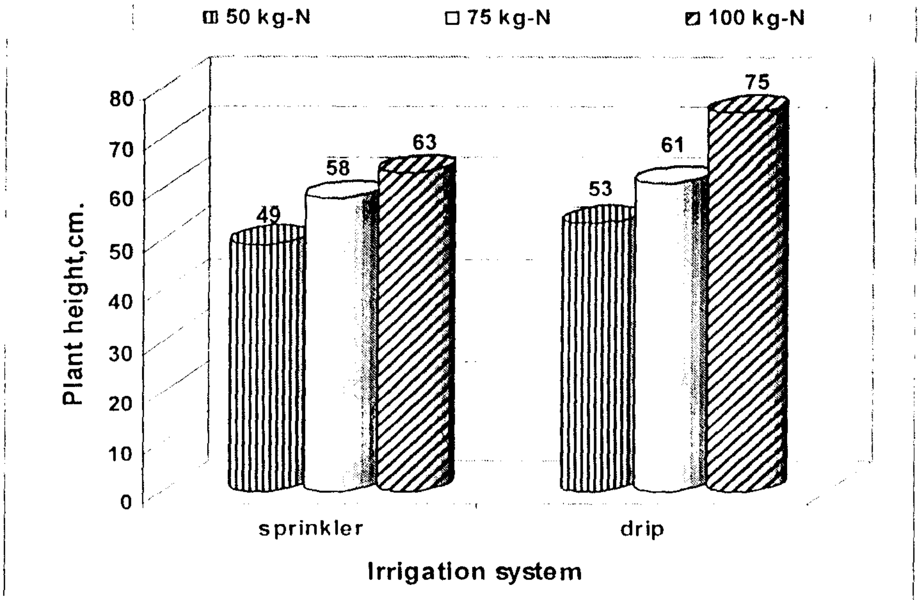

Fig. 4. Effect of fertilization treatments on plant height under trickle and sprinkler irrigation systems

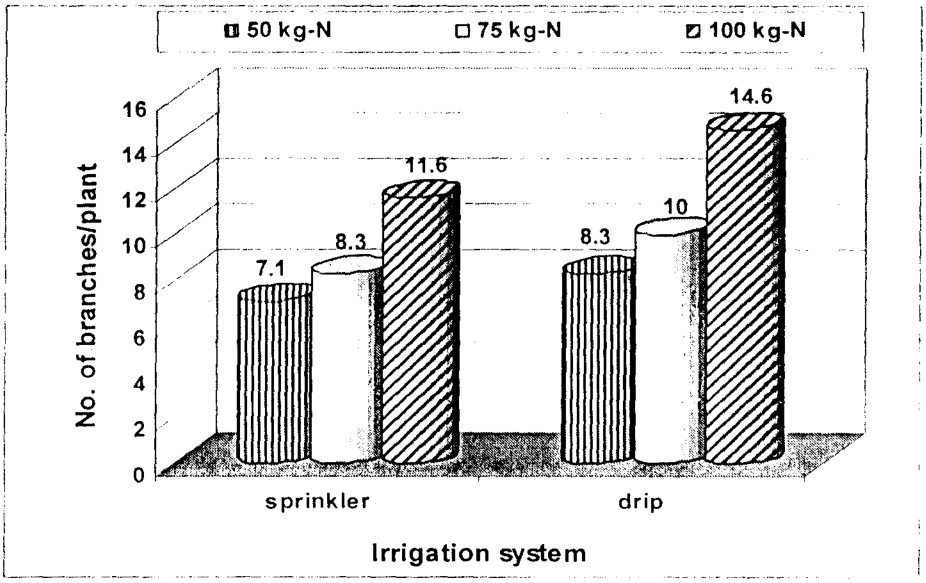

Fig. 5. Effect of fertilization treatments on No. of branches/plant under trickle and sprinkler irrigation systems

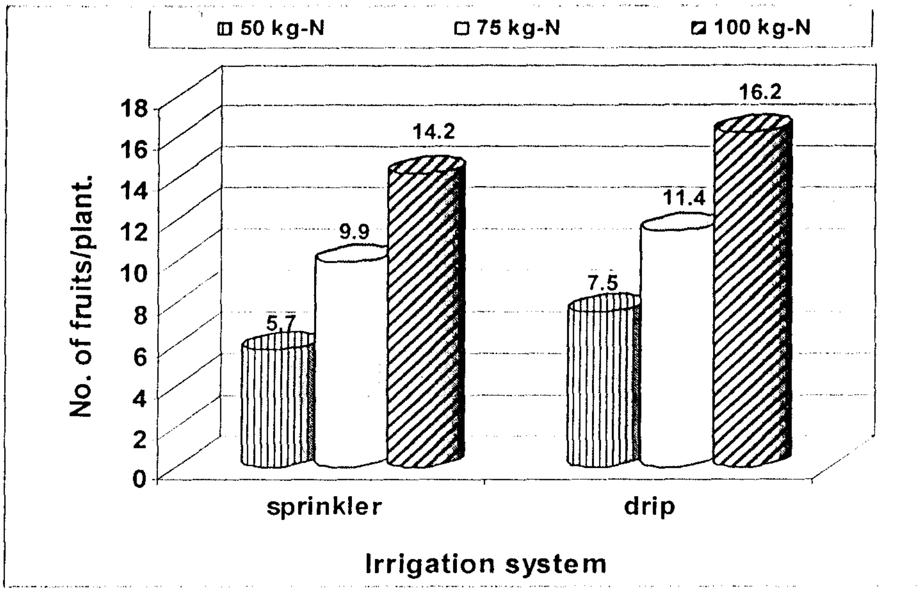

Fig. 6. Effect of fertilization treatments on No. of fruits/ plant under trickle and sprinkler irrigation systems

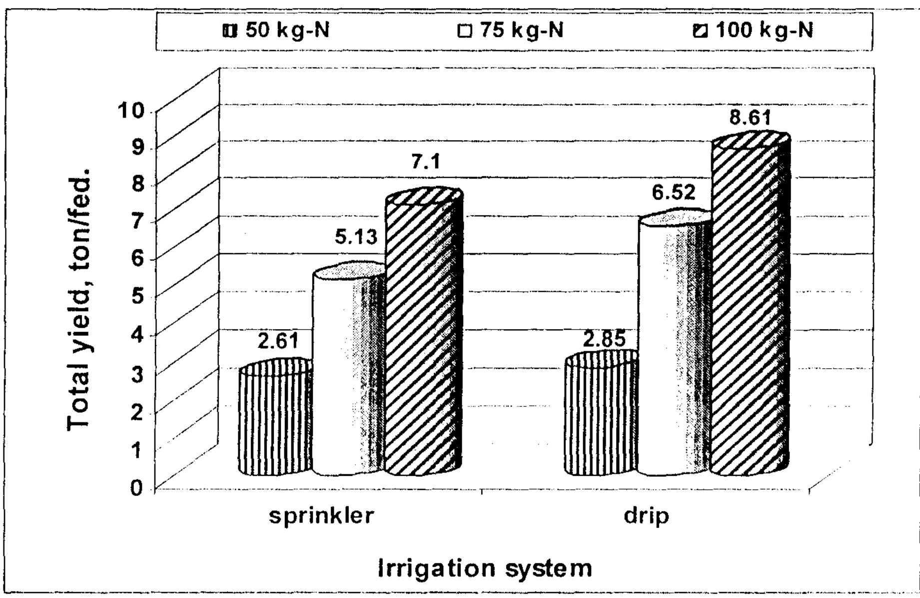

Fig. 7. Effect of fertilization rates on total yield under trickle and sprinkler irrigation systems

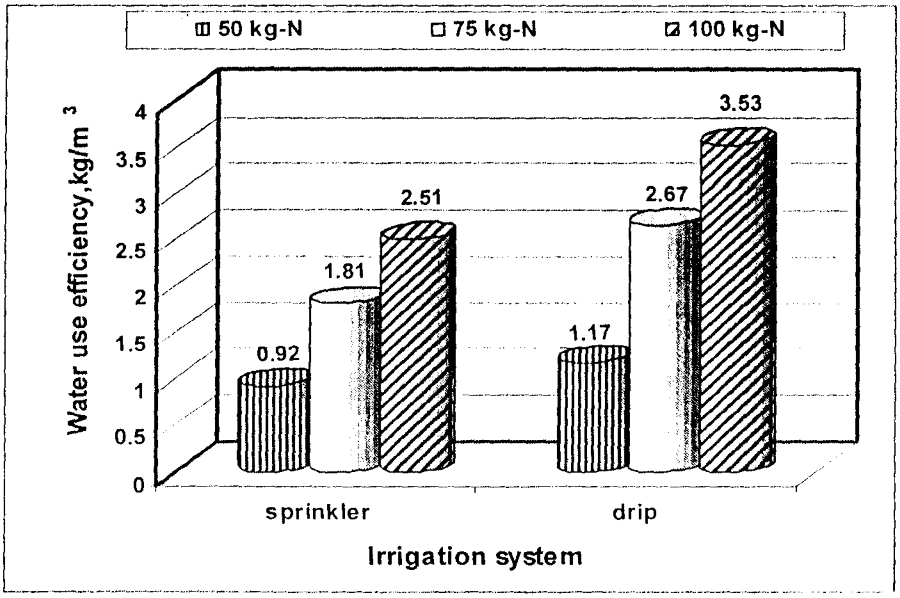

Fig. 8. Effect of fertilization treatments on water use efficiency under trickle and sprinkler irrigation systems

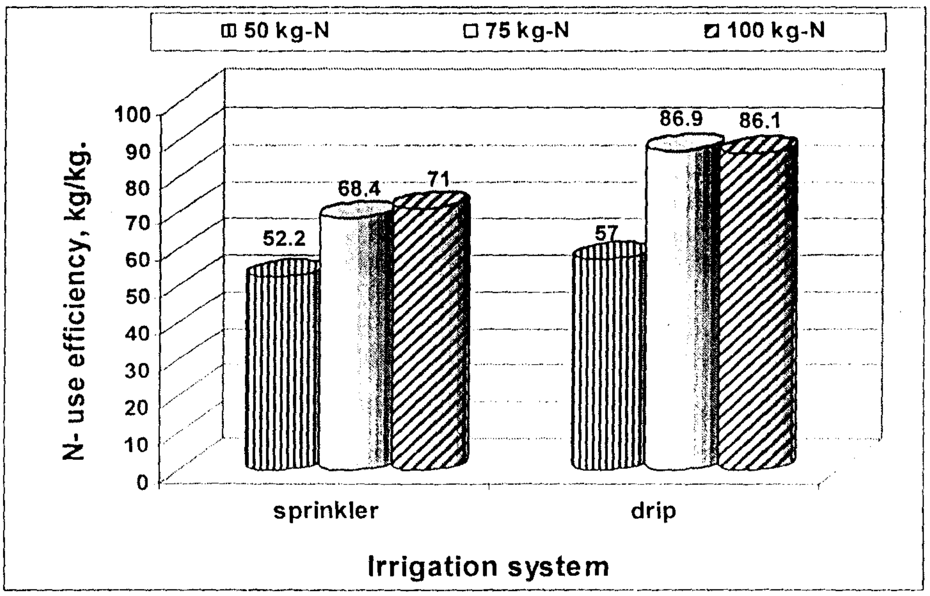

Fig. 9. Effect of fertilization treatments on nitrogen use efficiency under trickle and sprinkler irrigation systems

Table 5. Tomato production cost unit under different fertilization treatments and irrigation systems

Irrigation systems	Fertilization rates (kg-N/fed)	Total yield, ton/fed.	Total cost, LE/fed.	Production cost unit, LE/ton
Trickle	50	2.85	633.6	222.3
	75	6.52	701.1	107.5
	100	8.61	768.6	89.3
Sprinkler	50	2.61	603.6	231.3
	75	5.13	671.1	130.8
	100	7.10	738.6	104.0

CONCLUSIONS

Results could be summarized as follows

1- Irrigation efficiency under trickle irrigation (84.16%) was higher than that under sprinkler irrigation system (66.32%) by 17.84%.

2- Seasonal irrigation water requirements for tomato crop based on the climatic data (2439.9 and 2832.8 m^3/fed) was higher than estimated values using the soil samples method (1886 and 2153.1 m^3/fed) by 16.1% and 14.1% under both trickle and sprinkler irrigation systems, respectively.

3- Highest yield was obtained (8.61 ton/fed) when using trickle irrigation, compared to sprinkler irrigation (7.10 ton/fed) by an increase of 21.2%.

4- Water use efficiency under surface trickle irrigation (3.53 kg/m^3) was higher than that under sprinkler irrigation systems (2.51 kg/m^3) by 4.06 %.

5- There was no significant effect to irrigation method on the plant height, No. of branches/ plant, but there was an effect to irrigation method on No. of fruits/plant.

6- Tomato yield increased by 202% and 172% with increasing fertilization rate from 50 to 100 kg-N/fed under both trickle and sprinkler irrigation systems respectively.

7- The lowest cost of tomato production unit was 89.3 and 104 LE/ton under trickle and sprinkler irrigation systems respectively at fertilization rate of 100 kg-N/fed, while the highest cost of tomato production unit was 231.3 and 222.3 LE/ton under sprinkler and trickle irrigation systems at fertilization rate of 50 kg-N/fed.

8- The difference in the cost of tomato production unit when applying 75 and 100 kg-N/fed with trickle irrigation system was small

From the previous results, it could recommend using fertigation with rate of 75 kg-N/fed and applying 1886 m^3/fed of water under trickle irrigation system, while with sprinkler irrigation system, to use 100 kg-N/fed. and apply 2230.8 m^3/fed of water to produce tomato in sandy soils.

REFERENCES

Abdel-Aziz, A.A. (1998). Evaluation of Some Modern Chemigation Techniques., p. 92. Ph.D. Thesis, Fac. of Agric., Ain Shams University, Cairo, Egypt.

Abdel Maksoud, S.E. (1992). Study on Selecting the Proper System of Irrigation in New Lands. **Misr J. of Agric. Eng., 9(3): 347-357.**

Agricultural Statistics (2005). Economic Affairs Sector. Vol. 1, p. 601. Ministry of Agriculture and Land Reclamation, Cairo, Egypt.

Arnaout, M.A. (1995). A comparative Study Between Some Irrigation Systems. **Misr J. of Agric. Eng., 12(1): 46-54.**

Bianchi, M.I.; C.M. Burt and T.A. Ruhr (1985). Trickle Fertilization Practices and Soil Permeability. **Proc. of 3rd Int. Drip/Trickle Irrigation Conf., Fresno, Calif. pp. 357-363.**

Black, C.A. (1982). Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. Am. Soc. Agron. Madison. Wisconsin, USA.

Burt, C.M.; A.J. Clemmens; T.S. Strelkoff; K.H. Solomon; R.D. Bliesner; L.A. Hardy; T.A. Howell and D.E. Eisenhauer (1997). Irrigation Performance Measures: Efficiency and Uniformity. **J.**

of Irr. and Drain. Div., ASCE, USA, 123(6): 423-442.

Chase, R.G. (1985). Phosphorus Application through Subsurface Trickle System. **Proc. of 3rd Int. Trickle/Trickle Irrigation Conference, pp. 393-400.**

Doorenbos, J. and W.O. Pruitt (1977). Guidelines for Predicting Crop Water Requirements. **FAO Irrigation and Drainage, Paper 24. 156 pp.** Rome, Italy.

El-Gindy, A.M. (1988). Modern Chemigation Techniques for Vegetable Crops Under Egyptian conditions. **Misr J. of Agric. Eng., 5(1): 99-111.**

El-Gindy A.M. and A.A. Abdel-Aziz (2003). Maximizing Water Use Efficiency of Maize Cop in Sandy Soils. **Arab Universities Journal of Agric. Sci.,Ain Shams Univ., Cairo. 11 (1): 439-452.**

FAO (1984). Guidelines for Predicting Crop Water Requirements. **FAO Irrigation and Drainage, paper No. 24, 144 pp.** Rome, Italy.

Goyal, M.R.; L.F. Rivera and C.L. Santiago, (1995). Nitrogen Fertilization in Trickle Irrigation. Micro-irrigation for A Changing World, **Conserving Resources/Preserving the Environment, pp. 388-391**. Clovis, Ca., USA.

Hamdy, A. (1991). Fertigation: Prospects and Problems. **FAO, Consultation on Fertigation/ Chemigation, pp. 1-7.** Cairo, Egypt.

James, L.G. (1988). Principles of Farm Irrigation System Design. p. 543. John Wiley & Sons. New York, USA.

Khalifa, S.M. (2005). Utilizing Trickle Irrigation to Produce Pea in New Desert Land. **Proc. 13th Annual Conference of the Misr Society of Agricultural Engineering, pp. 803-819.** Al- Azhar Univ., Cairo, Egypt.

Khalifa, S.M. (2006). Cotton Crop Production Using Different Irrigation Systems. **Proc. 14th Annual Conference of the Misr Society of Agricultural Engineering, pp. 1155-1174.** Ain Shams Univ., Cairo, Egypt.

Sallam, M.F.A. and A.A.G. Abdalla (2002). Effect of Water Stress and Nitrogen Rates on Growth and Yield of Common Bean Plant Grown in Sandy Soil Under Sprinkler Irrigation. **Misr, J. of Agric. Eng., 19(2): 525-539.**

Seleman, M. (1993). Fertigation and Its Evaluation in Newly Reclaimed Soils, p. 1. M.Sc. thesis. Fac. Agric., Ain Shams Univ., Cairo, Egypt.

Smith, J. and P.J. Watts (1986). Analysis and Design of Gated Irrigation Pipelines. **Agric. Water Mamagement,12: 99-115.**

Vermeiren, I. and A. Jobling (1980). Localized Irrigation. Design installation, Operation and Evaluation. **FAO Irrigation and Drainage. Paper No. 36, p. 203.** Rome, Italy.

Worth, B. and J. Xin (1983). Farm Mechanization for Profit. p. 269. Granada Publishing. London, UK.

Wu, I.P. and H.M. Gitlin (1975). Irrigation Efficiencies of Surface, Sprinkler and Trickle Irrigation. **Proceeding Second World Congress International Water Resources Association, pp. 191-199,** New Delhi.

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الاحتياجات المائية والسمادية لمحصول الطماطم تحت نظامى الرى بالرش والتنقيط فى الاراضى الرملية

[٢٤]

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تم تجهيزمساحة ٢فدان بالمزرعـة الـصحراوية التابعة لكلية الزراعة - جامعة عين شـمس بمنطقـة البستان، محافظة البحيرة (تربة رملية) بهدف تقـدير الاحتياجات المائية والـسمادية لمحـصول الطمـاطم المروية بنظامى الرى بالرش والتنقيط فى الاراضـى الرملية، وذلك بحرث الارض مرتان متعامدتان مـع أضافة سماد الكتكوت بمعدل ١٠م^{3} للفدان مع ٢٥٠كج سوبر فوسفات ١٥,٥% فو$_{2}$أ$_{5}$، ثـم تخطـيط الارض على مسافات ٧٥سم لزراعـة محـصول الطمـاطم (صـنف كاسـل روك) فـى موسـمى النمـو (٢٠٠٥/٥/١٠) بعد تجهيز الارض بنظامين للـرى هما (الرى بالرش والرى بالتنقيط) ، وقد تـم تنفيـذ معاملات التسميد مع مياه الرى بثلاث معدلات سمادية هى (٥٠ ، ٧٥ ، ١٠٠كج نيتروجين/فدان).

وكانت أهم النتائج المتحصل عليها هى

١- كانت كفاءة نظام الـرى بـالتنقيط (٨٤,١٦ %) تزيد بنسبة ١٧,٨٤% بالمقارنة بنظـام الـرى بالرش (٦٦,٣٢%).
٢- الاحتياجات المائية لمحصول الطماطم والمحسوبة مـن البيانـات المناخيـة (٢٤٣٩,٩، ٢٨٣٢,٨م٣/فدان) تزيد عن الاسـتهلاك المـائى الفعلى بنسبة ١٦,١%، ١٤,١% باستخدام كل من نظامى الرى بالتنقيط و الرش على الترتيب.
٣- حقق نظام الرى بالتنقيط أعلـى انتاجيـة (٨,٦١ طن/فدان) بالمقارنة بنظام الرى بالرش الذى حقق (٧,١٠ طن/فدان) بزيادة مقدارها ٢١,٢%.
٤- كانت كفاءة أستخدام المياه تحـت نظـام الـرى بالتنقيط (٣,٥٣كج/م^{3}) أعلى منها تحـت نظـام الرى بالرش (٢,٥١كـج/م^{3}) بزيـادة مقـدارها ٤٠,٦%.
٥- عدم وجود تاثير معنوى لطريقة الرى على كـل من أرتفاع النبات، عدد الافرع/نبات.
٦- زيادة أنتاجية محصول الطماطم بنسبة ٢٠٢% ، ١٧٢% بزيادة معـدل التـسميد مـن ٥٠ الـى ١٠٠كج نيتروجين/فدان مع كل من نظامى الرى بالتنقيط والرش على الترتيب.
٧- كانت أقـل تكلفـة لوحـدة الانتـاج (٨٩,٣ ، ١٠٤جنيه/طن) فى حالة التسميد من خلال الرى بالتنقيط والرش بمعدل ١٠٠كج نيتروجين/فـدان، بينما أعلى تكلفة (٢٣١,٣ ،٢٢٢,٣جنيه/طن) فى حالة التسميد من خلال نظـامى الـرى بـالرش والتنقيط بمعدل ٥٠كج نيتروجين/فدان.
٨- الفرق فى تكلفة انتاج الطن من الطماطم فى حالة التسميد بمعدل ٧٥، ١٠٠ كج نيتروجين/فدان من خلال الرى بالتنقيط صغير.

من النتائج السابقة يمكن التوصية بإنتاج الطماطم فى الاراضى الرملية مع أضافة ٧٥ كج نيتـروجين و١٨٨٦ م^{3} من المياه للفدان تحت نظام الرى بالتنقيط، وبأضافة ١٠٠كج نيتروجين للفـدان و ٢١٥٣,١ م٣ من المياه باستخدام نظام الرى بالرش.

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