

EFFECT OF IRRIGATION WATER AMOUNTS AND NITROGEN RATES ON OPTIMUM MAIZE YIELD AND NET RETURN UNDER DRIP IRRIGATION SYSTEM AT NORTHWEST DELTA, EGYPT

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ABSTRACT

Two field experiments were carried out at Wady Elnatron, El-Behera Governorate, "Wady Elnatron located in the west desert near the Delta about 90 kilometers north west of Cairo", during 2008 and 2009 seasons to study the effect of irrigation water amounts and nitrogen rates on maize yield and the net return from these treatments 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 (ET_c). The sub-plots were randomly assigned by four nitrogen rates (zero, 50, 100 and 150 kg N fed.⁻¹) as ammonium nitrate (ha = 2.4 fed.). 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 (X_m and X_{opt}) were increased by decreasing irrigation water amounts from 100% to 70% of ET_c in the two seasons.
2. The maximum and optimum maize yields (Y_m and Y_{opt}) were decreased by decreasing irrigation water amounts from 100% to 70% of ET_c in the two seasons.
3. The highest maximum yield (4.307 ton fed.⁻¹), the highest total value of yield (6394.5 L.E fed.⁻¹) and the highest return of N fertilizer (1744.5 LE fed.⁻¹) were obtained with 100 % of ET_c used in the two seasons.
4. The efficiencies of N rates (eX) were decreased by increasing N rates from N_0 to N_1 , N_2 and N_3 , respectively with different irrigation water amounts.
5. The relative efficiency (EX), the efficiency of nitrogen fertilizer at optimum rate (eX_{opt}) and the efficiency of soil nitrogen (eX_s) were decreased as irrigation water amounts decreased.
6. The soil nitrogen content during plant growth (X_s) was decreased as irrigation water amounts decreased.
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 by increasing N levels in the two seasons.

Keywords: Maize, drip irrigation, N fertilization, irrigation water amounts, maximum and optimum N rates.

INTRODUCTION

Maize (*Zea mays* L.) is considered as one of the most important cereal crops in Egypt for its wide use in human and livestock feeding and industrial aspects. It ranks the second crop after wheat where it grows in the summer season. Total annual area cultivated with maize varieties was estimated 1.5-2.0 million feddans. Total national production of maize is about 5.43 million

tons, while the demand is for at least 7.0 million tons (El-Atawy and Eid, 2010). This reflects the size of the problem and efforts that needed to increase maize production. This can be achieved by breeding high yielding varieties and by the application of improved agro-techniques.

Water resources in Egypt are limited. So, saving water is a vital demand to face the water gap problem. Crop water management and its yield in different environments are very important concern in irrigation planning and maximizing grain yield. Drip irrigation is a highly efficient means of delivering water uniformly to crops because of the high cost of installing and maintaining a drip system beside its suitability to some soil properties than the others. It has been used primarily in areas of relatively high water costs where irrigation efficiency is an important economic consideration. Corn is one of the most efficient field crops in producing higher dry matter per unit quantity of water (Viswanatha *et al.*, 2002). Corn cultivation requires large quantities of water seasonally to obtain a large crop (Ayotamuno *et al.*, (2007) reported that the maximum plant height and the other maize yield components increased with increasing irrigation water. Abdel-Hafez *et al.*, (2008) reported that the highest values of grain yield were obtained with irrigation at 1.3 ETc as compared to 1 and 0.7 ETc.

Nitrogen is considered as one of major nutrients required by the plants for growth, development and yield. Abdel-Mawly and Zanouny (2005) reported that N and K fertilizer applications had significant effect on yield of Zea maize. Ma and Subedi (2005) found a positive effect of all N treatment over the control regarding yield in Zea maize. Wajid *et al.*, (2007) reported that an increase in nitrogen application resulted in maximum stem length, 100-grain weight and grain yield of Zea maize.

The excessive use of nitrogen fertilizers represents the major cost of crop production and creates pollution of agroecosystem. 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 corn yield under different irrigation water amounts and the net return from these treatments.

MATERIALS AND METHODS

Two field experiments were carried out at Wadi Elnatron (30° 25' N latitude and 30° 20' E longitude), El-Behera Governorate, during 2008 and 2009 seasons to study the effect of irrigation water amounts and nitrogen

rates on maize yield and the net return from these treatments .The experimental field was fertilized by 10 m³ of chicken manure and 15 kg P₂O₅ as superphosphate under maize rows throw soil preparation.

Surface drip irrigation system which used was consisted of polyethylene pipes of 16 mm diameter as laterals with dripper of 4 L/h at 50 cm apart. The laterals were located 75cm apart, one lateral for each plants row. Irrigation water was filtered through gravel filters and refiltered through screen filters. The EC of irrigation water was 1.1dSm⁻¹. 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 soil.

Seasons	Sand %	Silt %	Clay %	Texture	EC * dSm ⁻¹ (soil paste)	pH● 1:2.5	Available nutrients (mg kg ⁻¹)		
							N	P	K
2007	74.4	13.65	11.95	Sandy loam	3.8	7.4	2.7	7.0	377
2008	74.5	13.70	11.80	sandy loam	3.9	7.6	2.8	6.0	380

* Soil paste extract ● 1: 2.5 soil water suspension

Split plot design was used with four replicates. The main plots were assigned by four irrigation water amounts (100 %, 90 %, 80 % and 70 %) of crop evapotranspiration (ETc). The sub-plots were randomly assigned by four nitrogen rates (0 (N₀), 50 (N₁), 100 (N₂) and 150 (N₃) kg N fed.⁻¹) as ammonium nitrate (33.5 N %) through the irrigation water using venture injection in six equals doses. The first dose added after thinning while the later doses were applied on weekly bases.

Maize seeds (*Zea maize cv. Single Hybrid 30 K8*) were manually planted in one row in dry soil on 25 and 20 of June in the first and second seasons respectively. The distance between hills was 25 cm and one plant/hill was left after 3 weeks from planting. All field practice was done as usually recommended for cultivation .Harvesting was done after 120 days from planting. Central area of 45 m² in each plot was kept for determining maize yield to eliminate any border effect.

The amount of water applied at each irrigation was measured by flow meter and calculated according to Keller and Karmeli (1974).The obtained data were statistically analyzed according to 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 maize 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 B₀ is the intercept, and B₁ and B₂ are the linear and quadratic coefficients, respectively. The constants B₀, B₁ and B₂ were calculated using the least squares method.

The maximum addition of fertilizer (X_m), the maximum yield (Y_m), the optimum rate of fertilizer (X_{opt}), the optimum yield (Y_{opt}), The efficiencies of N rates ($N_0, N_1, N_2,$ and N_3) (eX), the average of efficiency ($e\bar{X}$) of the fertilizer application rate (X) along the range from $X= 0$ to $X= i$, the efficiency of fertilizer at optimum rate (eX_{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.

$$1. X_m = - \frac{B_1}{2B_2} \quad \text{Balba (1961)}$$

$$2. Y_m = B_0 - \frac{B_1^2}{4B_2} \quad \text{Balba (1964)}$$

$$3. X_{opt} = \frac{Pr - B_1}{2B_2} \quad \text{Balba (1964)}$$

$$4. Y_{opt} = B_0 + \frac{Pr^2 - B_1^2}{4B_2} \quad \text{Balba (1964)}$$

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

$$5. e\bar{X} = B_1 + B_2 X_i \dots \text{ at } X_i = 3 \text{ units} \quad \text{Thabet and Balba (1994).}$$

$$6. eX = B_1 + 2 B_2 X \quad \text{Thabet and Balba (1994)}$$

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

$$8. eX_s = \frac{B_0}{X_s} \quad \text{Thabet and Balba (1994)}$$

$$9. EX = 0.1 \sqrt{B_1^2 - 4B_0 B_2} \quad \text{Capurro and Voss (1981)}$$

$$10. X_s = \frac{-B \pm \sqrt{B_1^2 - 4B_0 B_2}}{2B_2} \quad \text{at } y = 0$$

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

$$12. \text{The contribution of soil N} = \frac{X_s}{X_f + X_s} \times \text{calculated yield}$$

$$13. \text{The contribution of fertilizer} = \frac{X_f}{X_f + X_s} \times \text{calculated yield}$$

RESULTS AND DISCUSSION

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

Table 2: The polynomial equations expressing yield of maize and irrigation water amounts of the two seasons 2008 and 2009.

Treatments	The polynomial equations	Xs N unit fed-1
100 % of ETc	$Y = 3.100 + 0.780 X - 0.126 X^2$	2.752
90% of ETc	$Y = 2.906 + 0.760 X - 0.142 X^2$	2.580
80 % of ETc	$Y = 2.446 + 0.672 X - 0.096 X^2$	2.643
70 % of ETc	$Y = 2.090 + 0.679 X - 0.091 X^2$	2.341

The experimental and calculated maize 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 equation do not significantly differ from the experimental values for each treatment (Table 3).

Table 3: Observed and calculated maize yield ton fed.⁻¹ as affected by irrigation water amounts and nitrogen fertilizer rates of seasons (2008-2009).

Treatments	100 % of ETc		90% of ETc		80% of ETc		70% of Etc	
	observed	calculated	observed	calculated	observed	calculated	observed	Calculated
N ₀	3.100	3.100	2.899	2.906	2.448	2.446	2.108	2.090
N ₁	3.752	3.753	3.544	3.524	3.015	3.022	2.624	2.678
N ₂	4.156	4.155	3.837	3.857	3.414	3.407	3.137	3.083
N ₃	4.304	4.304	3.914.	3.907	3.598	3.600	3.288	3.306

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_m and X_{opt}) are the values of fertilizer required to give the maximum and optimum yields (Y_m and Y_{opt}). The maximum N rates (X_m) increased from 3.10 unit N fed.⁻¹ to 3.73 unit N fed.⁻¹ as irrigation water amounts decreased from 100 % of ETc to 70 % of ETc as the mean of the two seasons. The values of the optimum N rates (X_{opt}) also show the same trend, where it increased from 2.5 unit N fed.⁻¹ to 2.91 unit N fed.⁻¹ as irrigation water amounts decreased from 100 % of ETc to 70 % of ETc as the mean of the two seasons. On the other hand, the values of X_{opt} were less than the values of X_m whereas the X_{opt} 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 maize unit (ton). The increase of X_m and X_{opt} added may be attributed to two seasons. The first is the effect of irrigation water amounts on decomposition of chicken manure, where the soil nitrogen (X_s) decreased from 2.752 N unit fed.⁻¹ to 2.341 N unit fed.⁻¹ (Table 2). The

second is the decrease of fertilizer efficiency at optimum rate (eX_{opt}) where it decreased from 0.465 ton unit⁻¹ fed.⁻¹ to 0.414 ton unit⁻¹ fed.⁻¹ as irrigation water amounts decreased from 100 % of ETc to 70 % of ETc (Table 5). These results are in agreement with those obtained by Atia, et al. (2010)

Maximum and optimum yields:

Data presented in Table 4 show that the Y_m decreased as irrigation water amounts decreased from 100 % of ETc to 70 % of Etc, where Y_m decreased from 4.307 ton fed.⁻¹ to 3.357 ton fed.⁻¹ as the average of the two seasons. The highest Y_m value (4.307 ton fed.⁻¹) was obtained when 100 % of ETc was used. The decrease of Y_m was more than 22 % 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 Ahmet et al. (2006), Bao Zhong et al.(2006) and Ayotamuno et al.(2007) .

The values of Y_{opt} were less than the values of Y_m , where the values of Y_{opt} were obtained by substitution of "X" by corresponding values of X_{opt} in equations 1-4 found in Table 3. The values of Y_{opt} show the same trend of Y_m , where it decreased from 4.263 ton fed.⁻¹ to 3.295 ton fed.⁻¹ 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 from 6394.5 L.E.fed.⁻¹ to 4942.5 L.E.fed.⁻¹ by decreasing irrigation water amounts from 100 % of ETc to 70 % of ETc. This decrease was more than 22.7 % of the returns from applied optimum N rates as 100 % of ETc used.

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 corn under X_{opt} and the returns of maize under irrigation water amounts.

Treatments	X_m unit N fed. ⁻¹	X_{opt} unit N fed. ⁻¹	Y_m ton fed. ⁻¹	Y_{opt} ton fed. ⁻¹	Total values of yield LE fed. ⁻¹	Total values of yield at control L.E fed. ⁻¹	Return of N fert. L.E fed. ⁻¹	Fert. cost L.E fed. ⁻¹	Net return of fert. L.E fed. ⁻¹	Return L.E./1L.E. fed. ⁻¹	Fer./ Control Ratio.
100% ETc	3.10	2.50	4.307	4.263	6394.5	4650.0	1744.5	562.50	1182.00	2.101	0.375
90% ETc	2.68	2.15	3.923	3.883	5824.5	4359.0	1465.5	483.75	981.75	2.029	0.336
80% ETc	3.50	2.72	3.622	3.563	5344.5	3669.0	1675.5	612.00	1063.50	1.738	0.457
70% ETc	3.73	2.91	3.357	3.295	4942.5	3135.0	1807.5	654.75	1152.75	1.761	0.577

Price of maize = 1500 L.E. ton⁻¹

Fertilizer price = 225 L.E unit⁻¹

Fertilizer unit = 50 kg

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 2.101 when 100% of ETc

applied and the lowest one was 1.761 as 70 % of ETc used .On contrast the fertilizer / control ratio increased as ETc decreased from 100 % of ETc to 70 % of ETc (Table 4). This means that the loses of fertilizer increase as irrigation water amounts decreases and the utilization of fertilizer decreases this may be to the limited root distribution which reflect less root surface. These results are in agreement with those obtained by El- Hady and Wanas (2006) and El- Atawy (2007).

Efficiencies of nitrogen fertilizer and soil nitrogen:

The efficiencies of N rates (N_0 , N_1 , N_2 and N_3), the average efficiencies ($e\bar{X}$) the relative efficiency EX, the efficiency of soil nitrogen (eXs) and, the efficiency of optimum N rate (eX_{opt}) are presented in Table 5 . The efficiencies of N rates (eX) decreased as N rates increased from N_0 to N_3 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 0.780 ton unit⁻¹ fed.⁻¹ to 0.528, 0.276 and 0.024 ton unit⁻¹ fed.⁻¹ as N rates increased from N_0 to N_1 , N_2 and N_3 respectively as 100% of ETc used. The values of EX, eX_{opt} and eXs decreased as irrigation water amounts decreased from 100% of ETc to 90 %, 80 % and 70 % of ETc respectively. The values of EX increased from 0.147 to 0.149 ton unit⁻¹fed.⁻¹, and decreased to 0.118 and 0.111 ton unit⁻¹ fed.⁻¹as irrigation water amounts decreased from 100% of ETc to 90 %, 80 % and 70 % of ETc respectively

It is clearly from above 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), ($e\bar{X}$), EX, eXs and eX_{opt} under rrigation water amounts.

Treatments	eX (ton unit ⁻¹ fed. ⁻¹)				$e\bar{X}$	EX	eX_{opt}	eXs
	N_0	N_1	N_2	N_3				
100 % ETc	0.780	0.528	0.276	0.024	0.402	0.147	0.465	1.126
90 % ETc	0.760	0.476	0.192	-0.092	0.334	0.149	0.455	1.126
80 % ETc	0.672	0.480	0.288	0.096	0.384	0.118	0.411	0.925
70 % ETc	0.679	0.497	0.315	0.133	0.406	0.111	0.414	0.893

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 $\frac{X_s}{X_f + X_s}$ x calculated yield, and the

contribution of fertilizer source = $\frac{X_f}{X_f + X_s}$ x calculated yield.

The results are presented in Table 6 show that the contribution of N fertilizer increased as N rates increased from N₀ to N₁, N₂ and N₃ with the different irrigation water amounts. For example the values with 100 % ETc increased from 0.0 to 1.002, 1.749, and 2.247 ton fed.⁻¹ respectively. On contrast, the contribution of soil N decreased as N rates increased from N₀ to N₁, N₂ and N₃, respectively. Other irrigation water amounts take the same trend (Table 6). Thabet and Balba (1994) obtained similar results, where they stated that the contribution of N fertilizer to the wheat grain yields increased with the increase of fertilizer N application under different levels of tillage and the contribution of soil N to the wheat grain yields decreased with the increase in the fertilizer N application under different levels of tillage

Table 6: Contribution of soil N and added fertilizer to maize yield at different irrigation water amounts in combined analysis of 2008 and 2009 seasons.

Treatments	100% of ETc		90% of ETc		80% of ETc		70% of ETc	
	Soil N ton fed.	Fert. N ton fed. ⁻¹	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹
N ₀	3.100	0.000	2.906	0.000	2.446	0.000	2.090	0.000
N ₁	2.751	1.002	2.541	0.983	2.448	0.574	1.877	0.801
N ₂	2.406	1.749	2.171	1.686	1.939	1.468	1.662	1.421
N ₃	2.057	2.247	1.805	2.102	1.685	1.915	1.448	1.858
N _{opt}	2.234	2.029	2.116	1.767	1.757	1.806	1.470	1.825

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 0.267, 0.421 and 0.522 as N fertilizer increased from N₀ to N₁, N₂ and N₃ as 100% of ETc used .The other irrigation water amounts (90 % ETc, 80 % ETc and 70 % ETc) gave the same trend .The contribution fraction of soil N decreased with increasing N rates. The values of contribution fraction of soil N decreased from 1.0 to 0.733, 0.579 and 0.478 as N rates increased from N₀ to N₁, N₂ and N₃, 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 maize yield at different irrigation water amount as average of two seasons (2008 & 2009).

Treatments	100% of ETc		90% of ETc		80% of ETc		70% of ETc	
	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹	Soil N ton fed. ⁻¹	Fert. N ton fed. ⁻¹
N ₀	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
N ₁	0.733	0.267	0.721	0.279	0.810	0.190	0.701	0.299
N ₂	0.579	0.421	0.563	0.437	0.569	0.431	0.539	0.461
N ₃	0.478	0.522	0.462	0.538	0.468	0.532	0.438	0.562
N _{opt}	0.524	0.476	0.545	0.455	0.493	0.507	0.446	0.554

CONCLUSION

It could be concluded that the daily irrigation with 100% of ETc and fertilization with 155 kg N per feddan for high maize yield and fertilization with 136 kg N per feddan for best net return in sandy loam soils of Wady Elnatron region, Egypt and the similar conditions.

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تأثير كميات المياه المضافة لمحصول الذرة مع معدلات التسميد النتروجيني علي المحصول الناتج والعائد الاقتصادي

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أقيمت تجربتان حقليتان خلال موسمي 2008 و2009 بمنطقة وادي النطرون، محافظة البحيرة وذلك بهدف دراسة تأثير كميات مياه الري المضافة بالتنقيط ومعدلات التسميد النتروجيني التي تحقق أعلى عائد اقتصادي وأعلى محصول من نبات الذرة.

كان التصميم المستخدم هو تصميم القطع المنشقة مرتين في أربع مكررات وكانت المعاملات تحت الدراسة هي:

أولاً: معاملات الري:

تروي يومياً وبكمية مياه تعادل 100 % من جهد البخر نتج اليومي للمحصول

تروي يومياً وبكمية مياه تعادل 90 % من جهد البخر نتج اليومي للمحصول

تروي يومياً وبكمية مياه تعادل 80 % من جهد البخر نتج اليومي للمحصول

تروي يومياً وبكمية مياه تعادل 70 % من جهد البخر نتج اليومي للمحصول

ثانياً: معاملات التسميد النتروجيني:

كانت القطع الشقية لاربعة مستويات نيتروجينية هي: صفر ، 50، 100 ، 150 كجم نيتروجين كل فدان تم إضافة 10 م3سماد دواجن + 15 كجم سوبر فوسفات في خطوط الخيار قبل الزراعة وقد استخدمت أربع معاملات من معاملات الدرجة الثانية للحصول على النتائج التالية

1- أدي النقص في كميات مياه الري المضافة خلال الموسم إلى زيادة الجرعة السمادية اللازمة للحصول علي المحصول الأعظم والأمثل.

2- تناقص المحصول الأعظم والأمثل كلما تناقصت كميات مياه الري المضافة خلال الموسم.

3- كان أعلى محصول أعظم (4.307طن/فدان) و أعلى عائد اقتصادي (6394.5 جنيه مصري / فدان) وأعلى عائد صافى من السماد (1744.5جنيه مصري / فدان) مع المعاملة الأولى 100 % من جهد البخر نتج اليومي للمحصول خلال الموسم.

4-تناقصت كفاءة السماد المضاف مع زيادة معدلات السماد من 0 إلي 1، 2، 3 علي التوالي مع مختلف كميات مياه الري المضافة .

5- تناقصت قيم متوسط الكفاءة الكلية والكفاءة النسبية وكفاءة الإضافة المثلي وكفاءة النتروجين الأرضي مع النقص في كميات مياه الري المضافة

6- تناقص محتوى الأرض من النيتروجين خلال فترة نمو المحصول مع تناقص كميات المياه المضافة .

7- تناقصت مساهمة النتروجين الأرضي في المحصول الناتج مع زيادة معدلات السماد المضاف

8- ازدادت مساهمة النتروجين السمادي في المحصول الناتج مع زيادة معدلات السماد المضاف.

توصي الدراسة بري محصول الذرة الشامية في منطقة وادي النطرون والمناطق المشابهة بكمية مياه تعادل 100% من جهد البخر نتج اليومي للمحصول مع إضافة 155 كجم نيتروجين للفدان وذلك للحصول على أعلى محصول بينما تكون الإضافة 136 كجم نيتروجين للفدان للحصول على أعلى عائد اقتصادي.

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