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IMPROVING WATER PRODUCTIVITY FOR MAIZE AT NORTH DELTA SOILS, EGYPT

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ABSTRACT

Two field experiments were carried out at Kafr El - Sheikh Governorate during summer season of 2011 , the first one was conducted in Sakha farm (Normal soil) , while the second experiment was conducted at El- Hamoul district (saline soil) .

Split – split – plot design with three replicates was used. Where, the main plots were assigned to irrigation timing (15, 26 and 36 days) after life watering and then maize plants were exposed to depletion (20, 40 and 60 %) from available water. Sub plots were devoted to nitrogen fertilizer levels i.e. 0, 80, 100 and 120 kg Nfed^{-1}. , and the sub – sub – plots were occupied to compost treatments i.e. without and with compost application (3 ton fed $^{-1}$).

Results indicated that , under normal soil conditions , the highest value of water productivity was obtained by irrigation after 36 days after life watering followed by irrigation at 60 % depletion from available water as well as adding both compost and 120 kg Nfed^{-1} . While , in saline soil the highest value of water productivity was achieved by irrigation after 36 days after life watering followed by irrigation at 20 % depletion from available water in addition to compost and 120 kg Nfed^{-1}.

Keywords: Water productivity; Compost; Depletion from available water; Time of irrigation after life watering; Deficit Irrigation

INTRODUCTION

With a rapidly growing world population, the pressure on limited fresh water resources increases. Irrigated agriculture is the largest water consuming sector and it faces competing demands from other sectors, such as the industrial and the domestic sectors. With an increasing population and less water available for agricultural production, the food security for further generations is at stake. The agricultural sector faces the challenge to produce more food with less water by increasing crop water productivity in either the same production from less water resources, or a higher production from the same water resources, so this is of direct benefit for other water users.

Maize (*Zea Mays, L*) is a great important crop for both human and animal feeding. It ranks the third position among cereal crops. In Egypt, it is very important to increase production of maize to cover the gab between production and consumption. The highest maize production depended on many factors i.e. cultivars, and nitrogen fertilization (El – Bana and Gomaa, 2000).

Crop water productivity (WP) or water use efficiency (WUE), as reviewed by Molden *et al* (2003), is a key term in the evaluation of deficit irrigation (DI) strategies. Water productivity with dimensions of kgm^{-3} is defined as the ratio of the mass of marketable yield (Y_a) to the volume of water consumed by the crop (ET_a):

$$WP = \frac{Y_a}{ET_a}$$

ET_a refers to water lost either by soil evaporation or by crop transpiration during the crop cycle. Since there is no easy way of distinguishing between these two processes in field experiments, they are generally combined under the term of evapotranspiration (ET) (Allen *et al*., 1998).

In water-scarce regions, crops with high WP should be preferred, although this is not the only factor. Indeed, while high-energy fruit and grain crops (e.g. crops with high protein content) may have a lower absolute WP value Steduto and Albrizio, (2005), their nutritional value is higher, which should be considered when assessing these crops for use in drought-prone areas. WP values reported in literature vary according to whether authors express the denominator as the amount of water applied (the sum of rainfall and irrigation) or as the amount of water transpired (unproductive soil evaporation is not taken into account).

The present study is focusing on the effect of deficit irrigation, nitrogen fertilization and compost on maize water productivity under North Delta soils. Therefore, the objective of this investigation was to maximizing the maize water productivity under North Delta soils.

MATERIALS AND METHODS

Two field experiments were carried out during the growing season of 2011 in sakha (normal soil), and El – Hamoul location (saline soil) , Kafr El-Sheikh Governorate aiming to improve maize water productivity as affected by deficit irrigation, organic fertilization and nitrogen fertilization, The experimental design was split – split – plot design with three replicates. Where the main plots were assigned to irrigation timing (15, 26 and 36 days) after life watering and then maize plants were exposed to depletion (20, 40 and 60 %) from available water. Sub plots were devoted to nitrogen fertilizer levels i.e. 0, 80, 100 and 120 kg $Nfed^{-1}$, and the sub – sub – plots were occupied to compost treatments i.e. without and with compost application (3 ton fed^{-1}).The maize grains, cultivar (three ways cross 321) were sown in may 2011 for both locations. Some physical and chemical properties of the experimental soils are shown in Table 1.

To judge perfectly on the soil physical and chemical properties, these methods were used according to the global standard methods.

- Mechanical analysis for soil was carried out using the pipette method as described by Dewis and Fritas (1970).
- Bulk density was determined by using the undisturbed core samples according to Klute (1986).
- Soil organic matter Content was determined by walkley and black method described by Hesse (1971).
- Field Capacity and Wilting Point were measured by using Pressure membrane apparatus according to (Garcia 1978).

Table 1: Some physical and chemical properties of the studied soils before cultivation.

Soil properties		Normal Soil	Saline Soil
Physical properties	Sand %	16.9	16.56
	Silt %	26.5	23.64
	Clay %	56.5	59.8
	Soil Texture	Clay	Clay
	Field Capacity,%	40.8	41.8
	Wilting Point, %	20.3	21.2
	Bulk density,Mgm^{-3}	1.24	1.38
	Organic matter, %	1.85	1.55
Chemical properties	$CaCO_3$, %	2.45	4.4
	pH*	7.65	8.0
	EC **, dS^{-1}	1.88	5.6
	Ca^{++}, Meq L^{-1}	3.00	9.0
	Mg^{++}, Meq L^{-1}	4.10	12.3
	Na^{+}, Meq L^{-1}	12.8	38.1
	K^{+}, Meq L^{-1}	0.20	0.6
	CO_3^{--}, Meq L^{-1}	0.00	0.0
	HCO_3^{-}, Meq L^{-1}	4.50	4.0
	CL^{-}, Meq L^{-1}	8.90	26.7
	$SO4^{--}$, Meq L^{-1}	4.5	29.3

- ***pH was determined in soil :water suspension (1:2.5) , ** EC was determined in soil paste extract**

Amount of water applied:

With respect to water measurements, water was measured by using a rectangular sharp crested weir in case of normal soil (Sakha Location), the discharge was calculated using the following Formula: according to (Masoud, 1967)

$$Q = CLH^{1.5}$$

Where

Q: The discharge in cubic meters per second, L: The length of the crest in meters (1.84 m) , H: the head in meters , C: an empirical coefficient that must be determined from discharge measurements, 0.3.

While, Water measurements in case of saline soil (El Hamoul Location) was measured using cut throat flumes (20 x.90 cm) and (30 x 90 cm) according to Early (1975). Soil moisture was determined using TDR (Time Domain reflectometer) in Situ.

Leaching requirements were added to irrigation water applied in saline soil according to (Rhoades 1974 ; and Rhoads and Merril 1976) as the following equation :

$$LR = \frac{EC_w}{5(EC_e) - EC_w}$$

where:

LR = the minimum leaching requirement needed to control salts within the tolerance (ECe) of the crop with ordinary surface methods of irrigation

EC_w = salinity of the applied irrigation water in dSm^{-1}

EC_e = average soil salinity tolerated by the crop as measured on a soil saturation extract.

Water productivity:
It is defined as the weight of marketable crop production per the volume unit of applied irrigation where expressed as cubic meter of water, **Michael (1978)**. It was calculated by the following equation:

$$WP\ kgm^{-3} = \frac{Yield\ \ kgfed^{-1}}{total\ water\ applied\ m^{3}\ fed^{-1}}$$

Nitrogen Use Efficiency: was calculated as grain yield (kg) produced due to adding units of nitrogenous fertilizer.

$$N.U.E\ \ kg/N\ added = \frac{grain\ yield\ (kg)}{units\ of\ nitrogen\ fertilizer\ added}$$

Statistical analysis:
The data were statistically analyzed using analysis of variance (ANOVA) technique by irristat model version (4), Steel and Torrie (1980).

RESULTS AND DISCUSSION

- **Effect of irrigation, nitrogen fertilization and compost on grain and straw yield of maize:**

Illustrated data in Table 2 show that irrigation, N-fertilization and compost affected grain and straw yields and this effect was high significant.

1 – Normal soil:

Irrigation regime effect:

In case of irrigation timing treatments, after life watering irrigation, there are high significant differences between them, where 15 days after life watering irrigation gave the best values of grain yield followed by 26 days then 36 days. Also, data indicate that irrigation at 20% depletion from available water gave the highest grain yield 3.17 $tonfed^{-1}$ Followed by 3.11 and 3.00 $tonfed^{-1}$ for 40% and 60%, respectively and there are high significant differences between such treatments. Data also indicate that irrigation at 20% depletion from available water was the best irrigation treatment because of better availability of soil moisture during the irrigation cycle, which enhanced water and nutrient uptake (Abdel-Maksoud *et al*., 2002).

Nitrogen effect:

With regard to nitrogen fertilization and its effect on maize grain yield, increasing nitrogen application levels increased grain yield. Data in Table 2 show that 120 kg Nfed^{-1}, gave the highest grain yield followed by 100 kg N than 80 kg .while 0 kg Nfed^{-1} gave the lowest grain yield. The differences between treatments were high significantly.

Table 2: Means of grain yield, straw yield, of maize crop as affected by different treatments under normal and saline soil conditions

Treatments	Normal Soil		Saline Soil	
	Grain yield ,ton fed $^{-1}$	Straw yield ,ton fed $^{-1}$	Grain yield ,ton fed $^{-1}$	Straw yield ,ton fed $^{-1}$
Irrigation Timing after life watering irrigation (T)				
15 days	3.263	5.7	1.413	3.27
26 days	3.168	5.5	1.362	2.95
36 days	2.846	4.8	1.239	2.31
F-test	**	**	**	**
L.S.D 0.01	0.03872	0.06	0.0228	0.045
Depletion(D)				
20 %	3.178	5.66	1.327	3.14
40 %	3.117	5.36	1.356	2.86
60 %	3.001	5.09	1.330	2.53
F-test	**	**	**	**
L.S.D 0.01	0.03872	0.061	0.0228	0.047
D X T	**	**	**	NS
Nitrogen (N)				
0	1.73	4.06	1.243	1.87
80	3.30	5.54	1.328	2.90
100	3.37	5.79	1.371	3.17
120	3.98	6.09	1.411	3.44
F-test	**	**	**	**
L.S.D 0.01	0.0468	0.070	0.0276	0.057
NXT	**	**	**	**
DXN	**	*	**	**
D X N X T	**	NS	**	**
Compost (C)				
Without	2.844	5.11	1.325	2.46
With	3.354	5.63	1.351	3.23
F-test	**	**	**	**
L.S.D 0.01	0.03043	0.048	0.0179	0.037
C X D	**	**	**	NS
C X T	**	NS	*	**
C X N	**	**	**	**
CX D X T	**	**	NS	**
C X D X N	**	NS	**	NS
C X T X N	**	NS	**	**
CXDXTXN	**	NS	**	**

Compost effect:

It was also noticed that mean values of grain yield in case of compost were better than without compost and there are high significant differences between them.

With respect to interaction between different treatments and its effect on maize grain yield, data reveal that, there are high significant differences between such treatments with grain yield, where, interaction between 120 kg Nfed^{-1}, irrigation at 15 days after life watering irrigation, irrigation at 20 % depletion from available water combined with compost increased maize grain yield highly significant with compared with other treatments under normal soil conditions.

The same trend was observed with straw yield, while, regarding to interaction effect on maize straw yield , data in Table 2 reveal that , there are no significant differences between (D,N and T) , (C and T) , (C , D and N) , (C , T and N) and between (T , D , N and C).

2- Saline Soil:

Irrigation regime effect:

Irrigation timing after 15 days after life watering gave the highest grain yield 1.413 ton fed $^{-1}$. and this increasing was high significant followed by 25 and 26 days after life watering, respectively. Data also reveal that, irrigation at 40% depletion from available water increased the maize grain yield to 1.35 ton fed $^{-1}$. This increasing was highly significant with other treatments. While, there are no significant differences between irrigation at 20% and 60% depletion from available water.

Nitrogen effect:

Respecting to saline soil, data in Table 2 illustrate that, there are high significant differences between such treatments and grain yield. Where, applying 120 kg Nfed^{-1}gave the highest grain yield 1.41, ton fed $^{-1}$, followed by 100, 80 and 0 kg Nfed^{-1}. The differences between such levels were high significant. This may be due to the importance of nitrogen element for plant growth and development and it is an integral component of many compounds essential for plant growth processes including chlorophyll and many enzymes (Mkhabela *et al*., 2001).

Compost effect:

With respect to compost, data indicate that applying compost increased grain yield significantly to 1.351 ton fed $^{-1}$ as compared to 1.3 in case of without compost.

Interaction between such treatments increased maize grain yield highly significant specially, interaction between (N, T, D and C). Where, adding 120 kgNfed^{-1}, irrigation after 15 days after life watering and irrigation at 40 % depletion from available water combined with compost increased grain yield highly significant as compared to other treatments.

With respect to maize straw yield and its effect by irrigation regime, nitrogen levels and compost, data in Table 2 report that, there are high significant differences between such treatments and maize straw yield. While , there are no significant differences between (D and T) , (C and D) and (C , D and N) and straw yield .

- **Effect of nitrogen fertilization level, irrigation regime and compost on maize water productivity under normal and saline soils:**

Data presented in Tables 3 and 4 reveal the values of water productivity kg.m^{-3} as affected by irrigation, nitrogen fertilization and compost under both normal and saline soil conditions. Regarding these data, it can be obvious that, mean values of water productivity increased with decreasing amounts of water applied as well as increasing both nitrogen levels and with adding compost.

Table 3: Maize water productivity kg.m^{-3}under normal soil as affected by irrigation regime, nitrogen and compost.

Irrigation treatments T	D	N	Normal soil: Water applied, m3 fed $^{-1}$ C1	C2	Grain, kg fed^{-1} C1	C2	WP, Kg m-3 C1	C2
15 days	20 %	0	3354	3297	1758	1890	0.52	0.57
		80	3370	3304	3330	3750	0.98	1.13
		100	3377	3308	3380	3810	1	1.15
		120	3387	3316	4250	4500	1.25	1.35
		Mean	3372	3306	3179.5	3487	0.93	1.05
	40 %	0	3125	3012	1700	1820	0.54	0.6
		80	3165	3026	3130	3720	0.98	1.22
		100	3180	3039	3210	3790	1	1.24
		120	3193	3051	4199	4470	1.31	1.46
		Mean	3165	3032	3059.75	3450	0.957	1.13
	60 %	0	2752	2657	1680	1800	0.61	0.67
		80	2765	2667	3030	3710	1.09	1.39
		100	2773	2674	3120	3760	1.12	1.4
		120	2785	2682	4020	4460	1.44	1.66
		Mean	2768	2670	2962.5	3432	1.065	1.28
26 days	20 %	0	3212	3108	1720	1850	0.53	0.59
		80	3221	3122	3250	3670	1	1.17
		100	3229	3130	3280	3790	1.01	1.21
		120	3236	3139	4090	4480	1.26	1.42
		Mean	3224	3124	3085	3447.5	0.95	1.097
	40 %	0	2774	2628	1680	1800	0.6	0.68
		80	2779	2643	3220	3650	1.15	1.38
		100	2785	2652	3190	3720	1.14	1.4
		120	2792	2663	4050	4420	1.45	1.65
		Mean	2782	2646	3035	3397.5	1.085	1.277
	60 %	0	2806	2263	1620	1770	0.57	0.78
		80	2812	2268	3190	3640	1.13	1.6
		100	2818	2280	3120	3700	1.1	1.62
		120	2832	2275	3199	4390	1.12	1.92
		Mean	2817	2271	2782.25	3375	0.98	1.48
36 days	20 %	0	2848	2755	1650	1800	0.59	0.65
		80	2870	2766	2691	3560	0.93	1.28
		100	2884	2777	2890	3650	1	1.31
		120	2895	2789	3124	4100	1.07	1.47
		Mean	2874	2771	2588.75	3277.5	0.897	1.177
	40 %	0	2378	2325	1650	1750	0.69	0.75
		80	2383	2328	2589	3520	1.08	1.51
		100	2390	2335	2820	3610	1.17	1.54
		120	2400	2342	3050	4020	1.27	1.71
		Mean	2387	2332	2527.25	3225	1.0525	1.377
	60 %	0	2403	1855	1600	1700	0.66	0.91
		80	2407	1860	2490	3290	1.03	1.76
		100	2414	1862	2555	3330	1.05	1.78
		120	2420	1863	2890	3902	1.19	2.09
		Mean	2411	1860	2383.75	3055.5	0.9825	1.635
Overall mean			2867	2668	2844.9	3350	0.98	1.27

Table 4: Maize water productivity kg.m^{-3} under saline soil as affected by irrigation regime, nitrogen and compost.

Irrigation treatments T	Irrigation treatments D	N	Saline soil: Water applied, m3 fed^{-1} C1	Water applied, m3 fed^{-1} C2	Grain, kg fed^{-1} C1	Grain, kg fed^{-1} C2	WP, Kg m-3 C1	WP, Kg m-3 C2
15 days	20 %	0	2880	2700	1260	1350	0.43	0.5
		80	2915	2780	1400	1400	0.48	0.5
		100	2950	2890	1420	1450	0.48	0.5
		120	3000	2900	1450	1490	0.48	0.51
		Mean	2936	2817.5	1382.5	1422.5	0.46	0.50
	40 %	0	3590	2400	1300	1320	0.36	0.55
		80	3600	2430	1420	1430	0.39	0.58
		100	3650	2490	1460	1470	0.4	0.59
		120	3690	2499	1500	1520	0.4	0.6
		Mean	3632.5	2454.7	1420	1435	0.3875	0.58
	60 %	0	3200	2200	1290	1300	0.4	0.59
		80	3290	2280	1400	1420	0.42	0.62
		100	3300	2300	1420	1450	0.43	0.63
		120	3390	2380	1490	1495	0.43	0.63
		Mean	3295	2290	1400	1416.25	0.42	0.61
26 days	20 %	0	2700	2500	1200	1320	0.44	0.52
		80	2730	2590	1320	1360	0.48	0.52
		100	2750	2600	1350	1370	0.49	0.53
		120	2800	2620	1400	1420	0.5	0.54
		Mean	2745	2577.5	1317.5	1367.5	0.47	0.52
	40 %	0	3200	1970	1280	1300	0.4	0.65
		80	3290	1995	1350	1360	0.41	0.68
		100	3300	2100	1420	1430	0.43	0.68
		120	3380	2120	1480	1490	0.44	0.7
		Mean	3292.5	2046.25	1382.5	1395	0.42	0.67
	60 %	0	3226	3195	1250	1280	0.39	0.4
		80	3280	3199	1300	1320	0.4	0.41
		100	3310	3220	1400	1415	0.42	0.43
		120	3399	3250	1420	1450	0.42	0.45
		Mean	3303.75	3216	1342.5	1366.25	0.40	0.42
36 days	20 %	0	2100	2000	1120	1150	0.53	0.57
		80	2150	2020	1200	1290	0.55	0.63
		100	2180	2100	1250	1295	0.57	0.62
		120	2200	2120	1280	1330	0.58	0.63
		Mean	2157.5	2060	1212.5	1266.25	0.55	0.61
	40 %	0	2730	2680	1160	1180	0.42	0.44
		80	2738	2690	1230	1260	0.44	0.47
		100	2740	2700	1280	1290	0.46	0.48
		120	2760	2710	1300	1315	0.47	0.48
		Mean	2742.0	2695	1242.5	1261.25	0.44	0.46
	60 %	0	2500	2410	1140	1160	0.45	0.48
		80	2520	2418	1200	1220	0.47	0.5
		100	2530	2420	1260	1260	0.49	0.51
		120	2580	2430	1270	1290	0.49	0.53
		Mean	2532.5	2419.5	1217.5	1232.5	0.475	0.505
Overall mean			2959.6	2508.5	1324.16	1351.38	0.45	0.54

Index:T: Time elapsed after life watering, D: irrigation at different levels of depletion from AW, N: Nitrogen fertilizer levels , C1: Without compost application, C2: With compost application

With regard to normal soil, data in Table 3 show that, increasing dose of nitrogen increased values of water productivity; this may be attributed to increasing grain yield under the same unit of water applied. Also, it was noticed that decreasing total water applied increased values of water productivity, where, the highest values of water productivity were 1.085 kg.m^{-3} under irrigation after 26 days after life watering combined with irrigation at 40 % depletion from available water and without compost application, while, 1.48 kg.m^{-3}under irrigation after 26 days after life watering followed by irrigation at 60 % depletion from AW with compost application. These results could be enhanced by those obtained by Zhang and Oweis (1999).

Regarding the compost and its effect on maize water productivity, data in Table 3 indicate that, mean values of WP increased to 1.27 kg.m^{-3} with compost as compared to 0.98 kg.m^{-3} without compost application, this may be due to increasing the water retention in soils in case of adding compost, as well as holding up more water in the crop root zone and allowing less to pass through into subsoil layers. Thus, compost can keep more water in case of deficit irrigation. Such results were obtained by Dalzell *et al* (1987).

With regard to saline soil, data in Table 4 show that increasing soil salinity decreased maize grain yield sharply, thus decreased values of WP as compared to normal soil. Data also indicated that, the highest values of WP 0.55 kg.m^{-3} was obtained by irrigation after 36 days after life watering followed by irrigation at 20 % depletion from AW without compost application. while in case of compost application , the highest value of WP 0.7 kg.m^{-3} was obtained when irrigation after 26 days after life watering followed by irrigation at 40 % depletion from AW . with respect to mean values of WP as affected by compost , data reported that compost application increased WP to 0.54 kg.m^{-3} as compared to 0.45 kg.m^{-3} without compost application ,This may be attributed to improving soil properties such as water holding capacity and soil aeration (Tate, 1987, Patel *et al*., 1993; Schoenau *et al*., 2004), regulate soil pH, decreases harmful effect of salts, improve nutrient availability (Deluca and Deluca, 1987; Singh *et al*., 2000), nutrient recycling (Cook, 1982) and serve as a source of plant nutrient (Freeze and Sommer, 1985; Campbell *et al*., 1986).

- **Effect of irrigation regime, nitrogen fertilization and compost on nitrogen use efficiency (NUE):**

Regarding normal soil it is defined as the amount of harvested crop that is produced per unit of nitrogen supplied during the growing season. Data in Table 5 show that, compost application gave the highest value of NUE kg/N unit as compared to those without compost application. It is well known that increasing nitrogen units led to an increase in yield according to Mitscherlich Theory, so we can observe that nitrogen sue efficiency attributed by N100 is higher than the same obtained by N120 in all irrigation treatments.

Where, the highest values of NUE were obtained by irrigation after 15 days of life watering irrigation as well as irrigation at 20% depletion from available water followed by irrigation after 26 & 36 days after life watering and also irrigation at 40 and 60% depletion from available water, respectively. These results were in accordance with Abdel Razek *et al*. (1999) & Abdel Maksoud *et al*. (2002).

Table 5:Effect of irrigation regime, N fertilizers and organic fertilizers on Nitrogen Use Efficiency under normal soil conditions

Time elapsed after life watering irrigation	Levels of depletion from available water	N-Fertilizers , Kg Nfed $^{-1}$	N.U.E , Kg/N unit	
			Without Compost	With Compost
15 days	20 %	0	-	-
		80	41.62	46.87
		100	33.80	38.10
		120	35.41	37.50
	mean		**36.94**	**40.82**
	40 %	0	-	-
		80	39.12	46.50
		100	32.10	37.90
		120	34.99	37.25
	mean		**35.40**	**40.55**
	60 %	0	-	-
		80	37.87	46.37
		100	31.20	37.60
		120	33.50	37.16
	mean		**34.19**	**40.37**
26 days	20 %	0	-	-
		80	40.62	45.87
		100	32.80	37.90
		120	34.08	37.33
	mean		**35.83**	**40.36**
	40 %	0	-	-
		80	40.25	45.60
		100	31.90	37.20
		120	33.75	36.83
	mean		**35.3**	**39.87**
	60 %	0	-	-
		80	39.87	45.50
		100	31.20	36.50
		120	26.65	36.58
	mean		**32.57**	**39.52**
36 days	20 %	0	-	-
		80	33.63	44.50
		100	28.90	36.50
		120	26.03	34.16
	mean		**29.52**	**38.38**
	40 %	0	-	-
		80	32.36	44.00
		100	28.20	36.10
		120	25.41	33.50
	mean		**28.65**	**37.86**
	60 %	0	-	-
		80	31.12	41.12
		100	25.55	33.30
		120	24.08	32.51
	mean		**26.91**	**35.64**
	General mean		**32.81**	**39.26**

Table 6: Effect of irrigation regime, N fertilizers and organic fertilizers on Nitrogen Use Efficiency under Saline soil conditions

Time elapsed after life watering irrigation	Levels of depletion from available water	N-Fertilizers , Kg Nfed $^{-1}$	N.U.E , Kg/N unit	
			Without Compost	With Compost
15 days	20 %	0	-	-
		80	17.5	17.62
		100	14.2	14.5
		120	12.08	12.41
	mean		**14.59**	**14.84**
	40 %	0	-	-
		80	17.75	17.87
		100	14.6	14.7
		120	12.5	12.66
	mean		**14.95**	**15.07**
	60 %	0	-	-
		80	17.5	17.75
		100	14.2	14.50
		120	12.41	12.45
	mean		**14.7**	**14.9**
26 days	20 %	0	-	-
		80	16.5	17.0
		100	13.5	13.7
		120	11.66	11.83
	mean		**13.88**	**14.17**
	40 %	0	-	-
		80	16.87	17.0
		100	14.20	14.3
		120	12.33	12.41
	mean		**14.46**	**14.57**
	60 %	0	-	-
		80	16.25	16.5
		100	14.00	14.15
		120	11.80	12.08
	mean		**14.01**	**14.24**
36 days	20 %	0	-	-
		80	15.0	16.12
		100	12.5	12.95
		120	10.6	11.08
	mean		**12.7**	**13.38**
	40 %	0	-	-
		80	15.37	15.75
		100	12.8	12.90
		120	10.83	10.95
	mean		**13.0**	**13.2**
	60 %	0	-	-
		80	15.0	15.25
		100	12.6	12.6
		120	10.58	10.75
	mean		**12.72**	**12.86**
	General mean		**13.89**	**14.14**

While in saline soil, Data in table 6 clearly show that the highest value of NUE were obtained by irrigation at 40% depletion from available water and irrigation after 15 days after life watering irrigation in case of without compost, where NUE value was 16.87 kg/N unit. Whereas, in case of compost application, data indicated that, the maximum value of NUE 17.87 kg/N unit was obtained by irrigation at 40% depletion from available water and after 15 days after life watering. These results were in accordance with Abd El-Razek *et al*. (1999) & Abdel-Maksoud *et al*. (2002).

- **Nitrogen Uptake by grain and straw under normal and saline soils**

Data in Figs 1 and 2 summarize that, mean values of N-Uptake were increased with increasing nitrogen level, deficit irrigation and compost application. Where, irrigation after 26 days after life watering followed by irrigation at 40 % depletion from available water combined with 120 kg Nfed^{-1}. Also, compost gave the highest values of N-Uptake by grain and Straw for both normal and saline soil.

Conclusion:

Under normal soil, maximum water productivity of maize could be achieved by irrigation after 36 days after life watering followed by irrigation at 60 % depletion from available water as well as adding 120 kg N fed $^{-1}$ and 3 tons compost. While, under saline soil, maximum value of water productivity could be achieved by irrigation after 26 days after life watering followed by irrigation at 40 % depletion from available water as well as adding 120 kg N fed $^{-1}$and 3 tons compost.

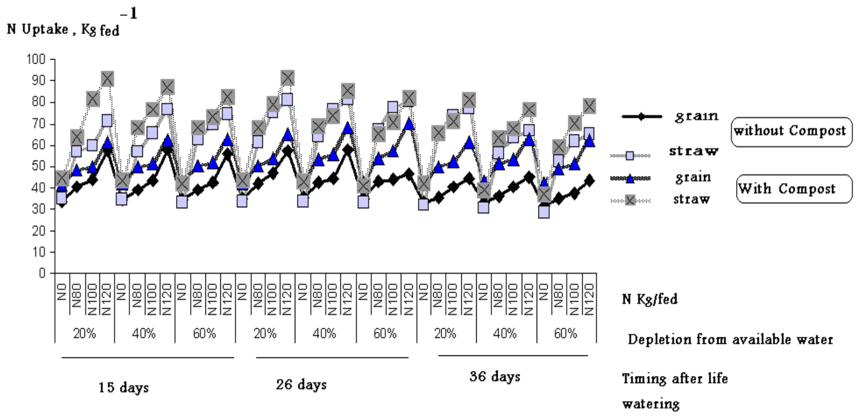

Fig 1: Effect of irrigation, N fertilization and compost on nitrogen uptake by grain and straw under normal soil conditions.

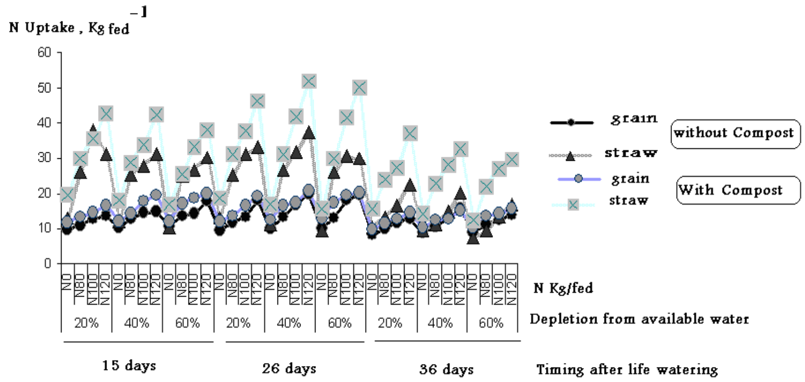

Fig 2: Effect of irrigation , N fertilization and compost on nitrogen uptake by grain and straw under saline soil conditions.

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تحسين انتاجية وحدة المياة من محصول الذرة الشامية فى اراضى شمال دلتا مصر

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قسم الاراضى – كلية الزراعة – جامعة المنصورة ، معهد بحوث الاراضى والمياة والبيئة – محطة البحوث الزراعية بسخا .

اقيمت تجربتان حقليتان فى محافظة كفرالشيخ خلال موسم 2011 ، وكان الموقع الاول عبارة عن ارض غير ملحية (سخا) والثانى كانت ارض ملحية بمركز الحامول وذلك بغرض تحسين انتاجية وحدة المياة من محصول الذرة نتيجة لتأثيرة بنقص كمية مياة الرى المضافة ، واضافة كلا من الكمبوست ومستويات مختلفة من السماد النيتروجينى . كان التصميم الاحصائى للتجربةعبارة عن قطاعات منشقة مرتين فى ثلاث مكررات ، حيث كانت المعاملات الرئيسية عبارة عن توقيت الرى بعد رية المحاياة (15 ، 26 ، 36 يوم بعد رية المحاياة) ثم استكمال بقية الموسم بالرى عند استنزاف نسب مختلفة من الماء الميسر (20 ، 40 ، 60 % من الماء الميسر) ، والمعاملات تحت الرئيسية كانت عبارة عن اربعة مستويات للتسميد النيتروجينى (0 ، 80 ، 100 ، 120 كجم ن /فدان) . بينما المعاملات تحت تحت الرئيسية كانت عبارة عن كمبوست (اضافة الموصى بة 3 طن فدان ، عدم اضافة) ، اظهرت النتائج انة تحت ظروف الارض غير الملحية فان اضافة الكمبوست ، الرى بعد 36 يوم من رية المحاياة ، الرى عند استنزاف 60 % من الماء الميسر ، وكذلك اضافة 120 كجم ن /فدان اعطى اعلى قيمة لانتاجية وحدة المياة . بينما فى حالة الارض الملحية فان اعلى قيمة لانتاجية وحدة المياة تم تحقيقها باضافة الكمبوست ، والرى بعد 26 يوم من رية المحاياة ، والرى عند استنزاف 40 % من الماء الميسر وكذلك باضافة 120 كجم ن / فدان .

قام بتحكيم البحث

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