IMPACT OF COMPOST, MINERAL FERTILIZATION AND IRRIGATION REGIME ON WHEAT AND SEQUENCED ZEA MAIZE PLANTS

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ABSTRACT: *Field experiment was carried out at El-Arish region, SWERI-ARC (2009). The experiment included the following treatments A) water supply treatments: I_1 =70% of WR (water requirement), I_2 =100% of WR and I_3 =130% of WR, B) fertilizer treatments involved: control, F_1 (50% compost ≈7.5 ton/fed.+50% NPK), F_2 (100% compost ≈15 ton/fed.) and F_3 (full recommended NPK). Wheat plants (Triticum aestivum L.) (Winter season) were grown under these treatments and followed by maize plants (Zea mays L.) (Summer season) to evaluate the residual effect of such treatments. The available soil nutrients and plant contents were measured, and yield was recorded.*

The results of the two successive seasons are summarized as followed. The available P and K, at the wheat tasseling, take the same trend, but it was contradicted line with that obtained in the available N. Mineral application had, of course, higher effect on those of N,P,K, but 100% water irrigation gave the less available N,P,K. The root biomass (g/plant) followed the same trend of shoots, whereas, higher irrigation water gave higher biomass. There were no differences among the effect of fertilizer treatments. Under all irrigation levels F_1 was the highest and control was the lowest effect. Irrigation levels affect significantly concentration and uptake of N, P and K in the shoots and roots, otherwise 130% irrigation gave higher N, K concentration, and 70% gave higher P. All fertilizer treatments increased N,P,K concentration and uptake more than control. Wheat spike and grain yield followed the same trend and 100% irrigation level recorded the highest effect on them.

The treatments contain organic had affected on yield parameters more than control or full mineral fertilizers. F_1 treatment under 100% then 130% irrigation levels gave higher grain yield. The recorded maize yield parameters (cob/ear, grain/ear, grain yield) were significantly increased by using all fertilizer treatments compared with control. The water use efficiency of wheat increased gradually in the order I_2>I_3>I_1.Composts increased WUE for wheat and maize at the applied irrigation treatments.

Key words: *Irrigation management – compost - mineral fertilizers - wheat – maize.*

INTRODUCTION

Increasing demand for fresh water supply with growing demand for foods, there is a need to evaluate soil, water and crop as altered by compost and irrigation. Therefore, researchers, farmers and governments should come together to studying possible effect of reduced irrigation practices. Zwart and Bastiaanssen (2004) showed that with a rapidly growing world population, the pressure on limiting fresh water resources increases. Irrigation agriculture is the largest water-consuming sector and it faces competing demands from other sectors, such as the industrial and domestic sectors. With an increasing population and less water available for agricultural production, the food security for future generation is at stake. El-Hendawy and Schmidhalter (2010) given that water shortages currently plague almost every country in North Africa and Middle East, insufficient water supply for irrigation in these regions, even in the short term, will almost certainly become the norm rather than the exception. Therefore, water shortage events have gained increasing importance in both the scientific and political agendas.

Fertilizers and agrochemicals play a very important role in increasing land productivity and fertility. Although mineral fertilizers can be used to replenish soil nutrients removed in crop harvests, they are too costly to be used in large quantities for profitable production in developing countries. Integrated nutrient supply of inorganic and organic (compost and manures) sources is of great importance of productivity in intensive cropping system (Eghball *et al.* (2004), Fan *et al.* (2005), Tawfik (2006), Bhattacharyya *et al.* (2008) and Lakhdar *et al.* (2009).

The problem of low productivity of sandy soils may be ascribed not only arising from the lack of organic matter and available mineral nutrients especially N, P, and K but also decreasing its ability to reserve water. However, their application could be also a promising alternative to alleviate the adverse effects caused by water stress. Fan *et al.* (2005) demonstrated that both wheat and maize yields from the OM treatment were consistently greater than the N treatment. These results clearly showed a positive impact of annual application of organic materials such as straw and manure on these dryland crops. However, it is not clear whether the impact was due to improved water relationships resulting from increased SOM or improved fertility. Oktem (2008) concluded that despite the reduction of fresh ear yield, the number of marketable ears at 10% water deficiency (90% E_{pan}) was still high and acceptable for sweetcorn production. Ould Ahmed *et al.* (2010) indicated that good water management combined with appropriate soil management is necessary for sustainable crop production in drylands.

Zwart and Bastiaanssen (2004) reported that the great challenge of the agricultural sector is to produce more food from less water, which can be achieved by increasing Crop Water Productivity (WUE). The range of WUE is very large (wheat, 0.6–1.7 kg m^{-3} and maize, 1.1–2.7 kg m^{-3}) and thus offers tremendous opportunities for maintaining or increasing agricultural production with 20–40% less water resources. Fan *et al.* (2005) showed that the WUE values for OM+NP treatment was consistently higher than those for other fertilized treatments (CK, N, NP, OM), indicating that the combination of NP and organic materials resulted in the most efficient use of water. El-Hendawy and Schmidhalter (2010) showed that yield variables and WUE increased with increasing irrigation frequency and rate. Fusheng *et al.* (2010) reported that organic N plays a major role in enhancing canopy WUE.

The dependence of crop yields on water supply is a critical issue because of the increasing limiting water resources for irrigation. Many experiments have been used to test effects of fertilization on grain yield and its residual effect but few continuous supplemental irrigation studies are available from El-Arish region under dryland condition. So, the aims of this study are to: 1) determine the effect of supplemental irrigation occurring during the growth season on yield of field grown wheat and maize irrigated by a drip irrigation system, 2) evaluate the water use efficiency of wheat and maize in the dryland region of Egypt. 3) to determine the influence of compost application alone ore integrated with mineral fertilizers on yield and some morphological characteristics of wheat and maize under dryland condition.

The study attempts to quantify the optimum nutrient and irrigation frequency combinations for soil–water and nutrient management which will address water stress and low soil fertility problem.

MATERIALS AND METHODS

Two field experiments were carried out at in El-Arish research station (Latitude: 31 05 Longitude: 33 50 Elevation: 30 57) ARC, Ministry of Agricultural during two successive seasons (2009). First one was in winter season, which wheat plants were grown under the treatments of irrigation and compost. The second was in summer season, which maize plants were grown under the residual effects of the previous treatments.

This study was conducted to determine if supplemental irrigation and soil amendments can improve growth and yield of wheat plants (*Triticum aestivum* L.) followed by maize plants (*Zea mays* L.) irrigated by drip irrigation system under studied condition. Irrigation system used was a drip irrigation system with 50 cm-spaced emitters with flow rate of 4 L/h and three days irrigation interval.

Wheat grains were drilled on November 15th, and the crop was harvested on 5 May, while maize grains were drilled on May 15th, and the crop was harvested on 12 September. The recommended agriculture practices were done

The treatments: A) Water supply treatments

Irrigation treatments	Wheat		Maize	
	Applied water quantity (m^3/fed.)	No. of irrigation days	Applied water quantity (m^3/fed.)	No. of irrigation days
I_1 (70% of WR)	820	34	2418	32
I_2 (100% of WR)	1172	49	2418	32
I_3 (130% of WR)	1524	64	2418	32

B) Fertilizer treatments

1) F_0 (Control)
2) F_1 (50% compost ≈ 7.5 ton/fed. + 50% NPK)
3) F_2 (100% compost ≈ 15 ton/fed.)
4) F_3 (full recommended NPK = 120 kg N/fed. as ammonium sulfate + 30 kg P_2O_5/fed. as super phosphate + 24 kg K_2O/fed. as potassium sulfate).

The data of water requirement was calculated by average 8 years of meteorological parameters using CROPWAT computer model (FAO 1992), based on calculation using Penman Monteith equation and the Kc values presented in the program and also illustrated in FAO-56 (Allen *et al.* 1998).

The values of water treatments are distributed along the growth season with different crop growth stages. The amount of water received from rainfall represents 2, 0.4, 7, 12 and 7 mm for November, December, January, February and Marsh, respectively (The total= 28.4 mm). The amount of rainfall is considered every irrigation time. As for summer season, it is carried out to study the residual effect of the fertilization treatments, with full water requirement had been applied twice a week.

Three main plots were separated by 2m. The subplot area was (10.5 m^2). The fertilization treatments were added before sowing wheat. Under the same treatments and without any new additions, maize was planted to evaluate the residual effect of the previous additions of organic and chemical fertilizers. Some physical and chemical properties of the used soil and compost are given in Table (1).

Samples and analyses:

In each plot, four random soil cores were taken and mixed (approximately 0.5 kg of soil) from the 0-15 cm depth at 60 day of sowing wheat. Available nitrogen was determined by microkjeldahl apparatus (Page *et al.* 1982).Available phosphorus was estimated colourmetrically in 0.5 M $NaHCO_3$ extract at pH 8.5, according to Watanabe and Olsen (1965). Available K was extracted with "NH_4HCO_3-DTPA" according to Soltanpour (1985) and measured by flame-photometrically.

Table (1): Some properties of the soils and compost under study.

Soil		Compost	
Chemical properties		Compost properties	
pH	8.01	pH	5.30
EC (dS/m)	2.12	EC (dS/m)	4.50
Na^+ (me/l)	10.38	NH_4^+ (ppm)	6586
K^+ (me/l)	0.37	NO_3^- (ppm)	1902
Ca^{2+} (me/l)	6.66	OM (%)	22.80
Mg^{2+} (me/l)	3.73	OC (%)	13.20
HCO_3^- (me/l)	2.77	C/N ratio	16.5:1
Cl^- (me/l)	15.64	Total N (%)	0.8
$SO_4^=$ (me/l)	2.73	Total P (%)	0.47
$CaCO_3$ %	22.70	Total K (%)	0.93
Physical properties		Ask (%)	77.2
Clay (%)	5.20	Bulk density (gm/m^3)	0.69
Silt (%)	30.70		
Sand (%)	64.10		
Soil texture	Sandy loam		

Portions of dried shoot and root of wheat at 60 day of sowing were dried at 70C° to a uniform moisture level, weighed, ground and then wet-digested as described by Chapman and Pratt (1978). The digested aliquot was analyzed for nitrogen content which determined by microkjeldahl apparatus (Cottenie *et al.* 1982). Phosphorus was determined by ascorbic acid method (John, 1970) and potassium by flame-photometerically (Cottenie *et al.* 1982). At the end of both seasons the middle two rows of wheat and maize yields were recorded.

Data were statistically analyzed through analysis of variance (ANOVA) and least significant difference (LSD) at 0.05 probability level was applied. Both wheat and maize planted in a split-plot design, replicated three times, with three irrigation rates as a main plot and fertilization treatments as subplots (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

1. First experiment (compost application)

A). Available N, P and K (ppm) in soil at wheat tasseling.

Concerning the substantial improvement in available N obtained with the irrigation treatments in this study, it appears that, the superiority attributed to I_2 treatment (Table 2). This increment perhaps due to I_2 treatment is more suitable to decompose the organic compost and protects the N from leaching. As for effect of fertilization treatment on available N, it decreased significantly by the order: $F_2 > F_1 > F_3 > F_0$. This may be refers to importance of compost as a nitrogen reservoir. The interaction between water application levels and fertilization treatments was significant. Available N values were increased by the order $F_2 > F_3 > F_1 > F_0$ under I_1 condition, whereas the increasing irrigation rate (I_2), N values followed the order $F_2 > F_3 = F_1 > F_0$. While, under high irrigation level (I_3) available N take a contradict order $F_2 > F_1 > F_3 > F_0$. This means that, increasing water amount tend to rise leaching of mineral fertilizers and maximize role of compost as a slow release N fertilizer.

Table (2): Soil available N, P, and K (ppm) at wheat tasseling as affected by irrigation and fertilization treatments.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
I_1	F_0	36.60	3.02	191.27
	F_1	47.80	4.70	287.40
	F_2	57.30	6.20	334.00
	F_3	50.90	6.50	370.50
I_2	F_0	33.50	2.70	186.60
	F_1	50.50	3.90	280.50
	F_2	65.90	5.50	300.00
	F_3	50.30	5.90	345.50
I_3	F_0	33.80	3.10	194.50
	F_1	56.20	4.50	296.40
	F_2	61.40	5.87	336.50
	F_3	47.80	6.40	341.40
[illegible]		[illegible]	[illegible]	[illegible]
Mean	I_1	48.15	5.11	295.79
	I_2	50.05	4.50	278.15
	I_3	49.80	4.97	292.20
[illegible]		[illegible]	[illegible]	[illegible]
Mean	F_0	34.63	2.94	190.79
	F_1	51.50	4.37	288.10
	F_2	61.53	5.86	323.50
	F_3	49.67	6.27	352.47
[illegible]		[illegible]	[illegible]	[illegible]

It is also obvious that available P and K take the same trend. But it was contradict line with those obtained in available N, whereas I_1 treatment gave highest value and I_2 gave the lowest. In general, P and K availability increased in the order of $F_3>F_2>F_1>F_0$. This is true by using all irrigation treatment and may be contributed to 1) the main source of P and K is mineral fertilizers, 2) organic matter have a small amount of P, 3) compost need to be decomposed and balanced with soil in advance and there is no enough time to allow to complete degradation of compost. Although, the plots received organic matter reveled that more fertility than control. Similar results over 2 years were observed by Ghosh *et al.* (2008).

B).Shoot, root biomass (g/plant), shoot/root ratio and N,P,K concentrations of wheat at tasseling.

The dry weight of wheat shoots at tasseling (g/plant) increased significantly with increasing irrigation rate $I_3>I_2>I_1$ (Table 3) this may be attributed to the role of water in improving plant cells development. Irrespective of irrigation rates, fertilization treatments affected significantly dry weight of shoots. The F_1 treatment (50% compost+50%NPK) is considered the best followed by F_2 (100% compost).While the lowest value was obtained by F_0 (control) followed by F_3 (100% NPK). The interaction effect of irrigation and fertilization was not significant but it should be noted that, I_3 * F_1 treatment is the best (11.71 g/plant) and I_1 * F_0 treatment is the lowest (7.17 g/plant).

The root biomass (g/plant) followed the same trend of shoots where was $I_3>I_2>I_1$ (Table 3). No significant difference between treatments which received compost (F_1 and F_2) as well as between control (F_0) and mineral fertilization treatments. This could be due to under control and mineral fertilizers, the plant is suffering from water and nutrient stress, so it must be expand to gain it is requires of them. But the treatments which received compost (F_1 and F_2) no water or nutrients depletion, the dry matter of root was lower than other treatments. The studies reported by Mandal *et al.* (2009) enhanced these results.

Increasing amount of applied water decreased the ratio of shoot/root (Table 3), but it increased by adding compost. Under lowest rate of water (I_1) the superiority was to 100% compost, this could be referring to the ability of compost to reserve water and nutrients. By increasing the irrigation rate, available N was removed from root zone especially in 100% NPK treatment (Table 3). So that F_3 and F_0 gave the same value of shoot/root (2.78) under I_3 treatment.

Irrigation levels affect significantly N, P and K concentrations in shoot and root whereas I_3 gave higher N and K than I_2 and I_1, because more water induce more absorption of N and K, while I_1 treatment was more suitable for P absorption. No significances or few differences between nutrient concentrations of shoot (N, P and K) in F_2 and F_3 treatments. The lowest value is given by control followed by F_1 treatment, although F_1 treatment gave the highest value of dry weight. This may be due to dilution effect, or the other meaning, the small value of shoot render the nutrients more concentrated. As for nutrient concentrations of root, it was increased significantly by the order: $F_0<F_1<F_2<F_3$ with one exception, there was no significant deference in K% between F_2 and F_3 treatments. The interaction between irrigation and fertilization confirmed the trend obtained with individual treatment of irrigation or fertilization as previously discussed.

Table (3): Dry weight of shoot, root (g/plant), shoot/root ratio and its nutrient concentrations (%) at wheat tasseling as affected by irrigation and fertilization treatments.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
I_1	F_0	07.17	2.60	0.30	3.70	2.61	0.29	0.17	1.80	2.76
	F_1	09.88	3.50	0.50	4.00	2.44	0.40	0.40	2.30	4.05
	F_2	09.26	4.30	0.52	4.80	2.01	0.70	0.56	2.77	4.61
	F_3	08.55	4.70	0.59	5.10	1.99	0.70	0.60	2.63	4.31
I_2	F_0	08.54	1.70	0.23	3.00	3.18	0.22	0.19	1.05	2.69
	F_1	10.91	2.90	0.37	3.70	2.14	1.00	0.31	2.60	5.10
	F_2	10.23	4.00	0.47	4.10	2.65	1.30	0.40	2.90	3.87
	F_3	10.45	3.80	0.45	4.00	3.16	1.90	0.35	2.50	3.31
I_3	F_0	09.26	2.70	0.35	3.10	3.33	0.21	0.20	1.73	2.78
	F_1	11.71	3.93	0.43	4.30	2.31	1.27	0.43	2.50	5.08
	F_2	10.93	4.60	0.53	5.20	2.83	1.50	0.50	2.90	3.87
	F_3	10.08	4.20	0.55	5.00	3.63	1.90	0.63	2.70	2.78
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mean	I_1	08.72	3.78	0.48	4.40	2.26	0.52	0.44	2.38	3.93
	I_2	10.03	3.10	0.38	3.70	2.78	1.11	0.31	2.26	3.74
	I_3	10.50	3.85	0.47	4.40	3.03	1.22	0.44	2.46	3.63
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mean	F_0	08.32	2.33	0.29	3.27	3.04	0.24	0.19	1.53	2.74
	F_1	10.83	3.44	0.43	4.00	2.30	0.89	0.38	2.47	4.74
	F_2	10.14	4.30	0.51	4.70	2.50	1.17	0.49	2.86	4.12
	F_3	09.69	4.23	0.53	4.70	2.93	1.50	0.53	2.61	3.47
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

C). Nitrogen, phosphorus and potassium uptake of wheat shoot and root (mg/plant) at tasseling (Fig. 1).

Nitrogen, phosphorus and potassium uptake of wheat shoot and root affected significantly with irrigation treatments. These nutrient uptake increased by the order I_3>I_1>I_2 except K uptake of root whereas it decreased with decreasing irrigation rate (Fig 1). As for the effect of fertilization treatments on nutrient uptake values showed that N, P and K uptake of shoots take one trend and follow the order F_2>F_3>F_1> F_0. As for N, P and K uptake by root decreased gradually in the order F_3>F_2>F_1>F_0. The interaction effect of irrigation-fertilization treatments tended to increase nutrients uptake by shoot and root as compared to untreated plots. This support results of shoot and root dry weight in addition to values of nutrients concentrations. Such results suggest that, effect of 100% compost, or 100% mineral fertilizer produced more remarkably nutrients uptake of both shoot and root than adding 50%compost + 50%NPK and control. Rasool *et al.* (2007) reported that the uptake of N, P and K by wheat were higher with the application of FYM and inorganic fertilizers than in control plots.

D). Wheat spikes yield (g/spike) and grain yield (kg/fed.) at harvest

Data in Table (4) showed that Wheat spikes and grain yield follow the same trend. Irrigation treatments had a considerable effect on them and I_2 treatment (100% WR) is the best. The enhanced grain yield with I_2 may be interpreted by: 1) the more efficiency of nutrients in soil treated with I_2 compared with the others. 2) this amount of water more suitable to exporting the dry matter content to grains resulting more grain filling and weight as well as grain yield. 3) improving soil chemical and biological properties. 4) decreasing nutrient losses by leaching. 5) good aeration associated with the relatively low application of irrigation water (Abou-Baker 2008). Reducing water application rate from 100% WR (I_2) to 70% WR (I_1), reduced spikes and grain yield by 86.2 and 97.6% compared with I_1,while increasing water application rate from 100% WR (I_2) to 130% WR (I_3), also reduced spikes and grain yield by 3.5% and 3.8%, respectively. This indicates that under dryland condition effect of irrigation water reduction is higher than the side effects refer to increasing irrigation rate. Lower yield in I_1 treatment reflects less irrigation water applied in I_1 than other treatments. This is in agreement with those of Eghball *et al.* (2004) where they showed that lower grain yield under less irrigation water applied.

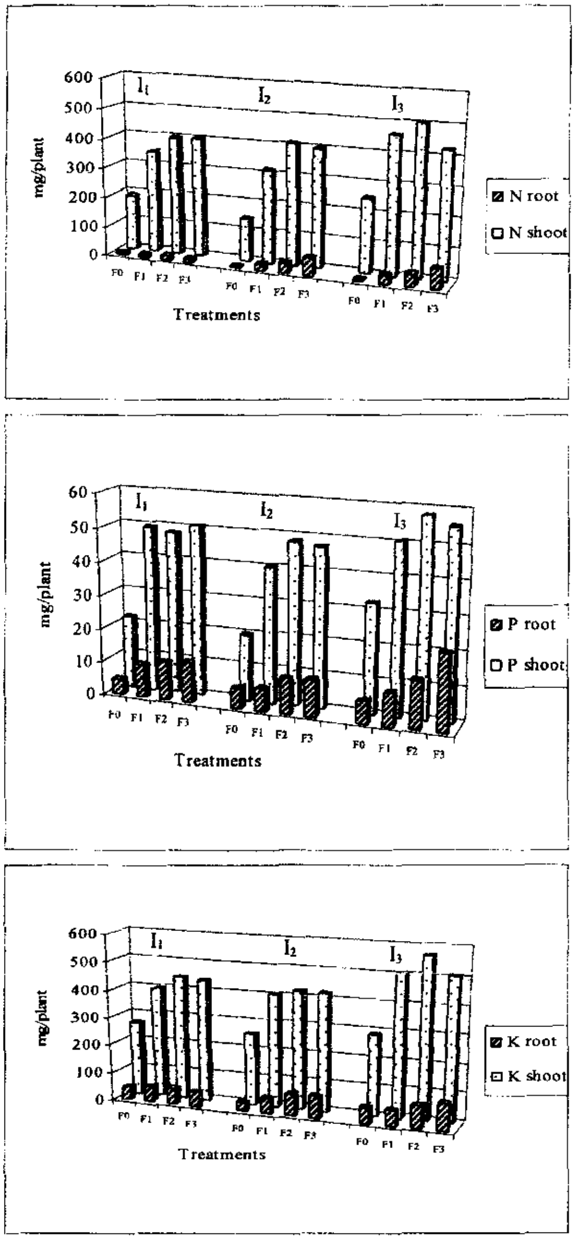

Fig. (1): Nitrogen, phosphorous and potassium uptake of wheat shoot and root (mg/plant) at tasseling as affected by irrigation and fertilization treatments.

Table (4): Wheat spikes yield (g/spike) and grain yield (kg/fed.) at the end of season as affected by irrigation and fertilization treatments.

Irrigation treatments	Fertilization treatments	Spike (g/spike)	Grain yield (kg/fed.)
I_1	F_0	1.21	731.8
	F_1	1.41	959.4
	F_2	1.28	851.6
	F_3	1.23	809.0
I_2	F_0	2.26	1466.7
	F_1	2.51	1821.7
	F_2	2.40	1669.3
	F_3	2.37	1666.3
I_3	F_0	1.92	1277.3
	F_1	2.48	1762.4
	F_2	2.44	1697.1
	F_3	2.39	1644.2
LSD at 5%		[illegible]	[illegible]
Mean	I_1	1.28	837.9
	I_2	2.39	1656.0
	I_3	2.31	1595.3
LSD at 5%		0.0[illegible]	[illegible]
Mean	F_0	1.80	1158.6
	F_1	2.13	1514.5
	F_2	2.04	1406.0
	F_3	2.00	1373.2
LSD at 5%		0.02	[illegible]

As for effect of fertilization treatments on both yield parameters, spikes and grains yield were significantly increased by using all rates of compost irrespective of mineral fertilizers. The lowest values were found by using control followed by full recommended dose of mineral fertilizer. These presumably resulted from advantage of soil fertility, soil structure and perhaps water infiltration. The superiority was recorded by using F_1 (50% compost + 50%NPK). Thus, a combination of NPK-fertilizer and compost could be the viable nutrient management option for wheat production. These results are consistent with the findings of Cox *et al.* (2001) they concluded that compost induced changes to soil quality did not translate into higher soil productivity until fertilizer N was applied. Mandal *et al.* (2009) they showed that grain yield of soybean and stover yields increased in NPK and NPK + FYM over control.

2. Second experiment (compost residual effect+100%WR)

Maize plant height (cm), cob/ear (g), grains/ear (g) and grains yield (kg/fed.) at harvest were recorded in Table (5). Data in Table (5) showed that as regard to the fertilization treatments, that the increase in plant height was significant with increasing organic fertilizer level, and arranged in the order $F_2>F_1>F_3>F_0$. These results may be due to 1) importance of compost as a slow release nitrogen fertilizer in increasing plant height. 2) the ability of compost to conserve water 3) fast desolation and washing of mineral fertilizers from root zone (table 5).

Cob/ear, grains/ear and grain yield were significantly increased by using all rates of compost as compared with control. The lowest values were found by using control followed by full recommended dose of mineral fertilizer. The highest values of these parameters obtained by adding 100% compost followed by 50% compost +50% NPK. It was in contradicting line with those obtained in wheat yield. Compost releases nutrients slowly at the wheat growth period and need to support by adding mineral fertilizers, but in maize growth period begins, the compost degradation increases and consequently, release more nutrients to maize plants.

Table (5): Plant height (cm), weight of cob/ear (g), weight of grains/ear (g) and grains yield at the end of season as affected by fertilizations treatments+100%WR of maize plants grown on El-Arish soil.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
F_0	136.17	20.53	98.81	837.6
F_1	168.51	31.32	129.90	1218.1
F_2	172.21	36.17	160.36	1436.5
F_3	164.24	24.29	113.64	1007.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Almost of these findings may be refer to one or more of the following reasons 1) improving soil physical, chemical and biological properties 2) The effect of applied compost on soil properties continue into the following year, because of slow decomposition of the compost. 3) the solubility effect of compost upon native and applied nutrients 4) the biodegradation of compost produce several organic acids which are able to reduce soil pH subsequently increasing nutrients availability. 5) compost contains various balanced nutrients. In practice, not only N, P and K nutrients but a combination of all the essential elements from the amendments was contributing to final yield values. Bhattacharyya *et al.* (2008) reported under the unfertilized and the inorganic fertilizer treatments that decreased with time, whereas they increased in the plots under N + FYM and NPK + FYM treatments for both crops.

3. Water use efficiency (WUE) of wheat yields as affected by irrigation and fertilization treatments, and maize yield as affected by residual effect of fertilizers+100%WR:

It is interesting to note that, rational irrigation and fertilization management are among the most important measures to improve grain yield and WUE toward better land use, minimize of production input costs, and improve the agricultural economy.

In general, WUE defined as biomass accumulation over water consumed, it is considered one of the parameters used to evaluate the performance of agricultural production systems. The WUE of wheat increased gradually in the order $I_2>I_3>I_1$, (Table 6). These results emphasized that low yields due to water stress didn't concomitant to low WUE values, and the increase in WUE didn't refer to high amount of water. This may be due to mathematically, WUE calculated as [yield (kg/fed.)/total water applied (m^3/fed.)], hence increasing water amount tend to raise the denominator of equation subsequently decrease the net result. It has been predicted that plants generally have the capability to optimize their water use in short term and maximize their chance of survival during drought in the long term. Concerning the effect of fertilization treatments irrespective of irrigation levels, data revealed that, WUE of wheat decreased gradually in the order $F_1>F_2>F_3>F_0$.

WUE of maize (residual fertilizers+100%WR) increased gradually, when increasing the amount of compost. Treating sandy soils with applying compost led to an increase in WUE by maize plants i.e. yield produced in kg by each m-cubic of irrigation water used. The differentiation between WUE of studied maize and the reference range of it, can be ascribed to nutrient management whereas, maize was grown after wheat without any new fertilizers addition. These results are in close association with Fan *et al.* (2005) they hypothesized that perhaps the WUE of manure+NP treatment could increase with time as soil organic matter increased, and they added that organic materials could increase water-holding capacity that, by turn, improves water availability to plants and arrests grain yield declines, and sustains productivity.

Table (6): Water use efficiency (WUE) for wheat yield as affected by irrigation and fertilization treatments, and maize yield as affected by residual effect of fertilizers under 100% WR.

Fertilization treatments	Wheat [illegible]				Maize plants [illegible] fertilizer 100% WR treatments
	Irrigation treatments			Mean (I)	
	I_1	I_2	I_3		
F_0	0.67	1.33	1.16	1.05	0.41
F_1	0.87	1.66	1.60	1.38	0.58
F_2	0.77	1.52	1.43	1.24	0.64
F_3	0.74	1.52	1.19	1.14	0.46
Mean (F)	0.76	1.50	1.34		0.52
[illegible]	[illegible]=0.12 F=0.14, IxF=ns				[illegible] F=0.02 [illegible]

Interaction effect of irrigation doses x fertilization treatments on WUE was not significant for wheat. Water use efficiency values ranged from 0.67 to 1.66 kg/m^3 for wheat. Zwart and Bastiaanssen (2004) mentioned that the globally measured averages are 0.6-1.7 kg/m^3 for wheat.

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تأثير المكمورات العضوية والاسمدة المعدنية و نظام الرى على نباتات القمح ونباتات الذرة الشامية

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الملخص العربى

اقيمت تجربة حقلية بمحطة بحوث العريش لدراسة تأثير الكمبوست (المكمورات العضوية) و التسميد المعدنى على نبات القمح المتبوع بنباتات الذرة تحت معدلات رى مختلفة. حيث كانت معاملات التسميد بالنسبة لنباتات القمح (١٠٠% عضوى (F_2)، ٥٠% عضوى +٥٠% معدنى (F_1)، ١٠٠% معدنى (F_3)، معاملة المقارنة(F_0)) وكانت معاملات الرى (٧٠% (I_1) ، ١٠٠% (I_2) ، ١٣٠% (I_3) من الأحتياجات المائية للمحصول)، كما درس التأثير المتبقى للتسميد بالنسبة لنباتات الذرة مع الأحتياجات المائية الكاملة للمحصول.

واظهرت النتائج ان اضافة الاسمدة المعدنية كان له تأثيرا عاليا على تركيزات كل من النتروجين والفسفور والبوتاسيوم الميسر فى التربة كما ان اضافة ١٠٠% من الاحتياجات المائية اعطت اقل تيسر للعناصر فى التربة .

سلك كل من المجموع الجذرى وكذلك الخضرى لنباتات القمح (جم/ نبات) نفس اتجاة النتائج حيث ان اوزانهما قد زادا بزيادة معدل الرى ولم يتأثرا معنويا باختلاف معاملات التسميد. كما أن إضافة معاملة (٥٠% عضوى +٥٠% معدنى) اعطت اعلى اوزان وكان اقلها مع الكنترول وذلك تحت جميع مستويات الرى.

اثرت معاملات الرى معنويا على تركيز وامتصاص النتروجين والفسفور والبوتاسيوم فى كل من المجموع الجذرى والخضرى حيث اعطت اضافة ١٣٠% من الاحتياجات المائية اعلى التركيزات للنيتروجين والبوتسيوم بينما اعطت اضافة ٧٥%

من الاحتياجات المائية أعلى تركيز للفوسفور .كما ادت اضافة جميع معاملات التسميد الى زيادة تركيز وامتصاص العناصرمقارنة بالكنترول.

ادت اضافة ١٠٠% من الاحتياجات المائية الى زيادة كل من محصول الحبوب واوزان السنابل فى القمح. كما ان المعاملات التى احتوت على اضافات عضوية اظهرت تفوقا على معاملات التسميد المعدنى بمفردة وكذلك الكنترول. وقد أدى اضافة ٥٠% عضوى + ٥٠% معدنى مع ١٠٠% من الاحتياجات المائية إلى انتاج أعلى محصول.

الاثر المتبقى لمعاملات التسميد العضوى اعطت اعلى وزن قوالح / كوز واعلى وزن حبوب / كوز واعلى محصول مقارنة بالتسميد المعدنى والكنترول.

وقد زادت كفاءة استخدام القمح للمياة عند اضافة ١٠٠% من الاحتياجات المائية يليها ١٣٠% واقلهم عند اضافة ٧٠% فى حين ان اضافة الآسمدة العضوية أدت الى زيادة كفاءة الرى تحت نفس معدل الرى المضاف وذلك مع القمح والذرة.