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Effect of Applied Organic and Bio-Fertilizers on the Productivity and Grains Quality of Maize Grown in Saline Soil

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A FIELD experiment was carried out at Sahl El-Tina, Gelbana Village No (7), Port Said Governorate, for two successive summer seasons. The effect of fertilization by organic compost, bio-fertilizer, *i.e.*, *Azospirilum barastlense* strain (Plant Growth Promoting Rhizobacteria PGPR), low amount of mineral N, elemental S and their combinations on maize productivity and grains quality of three varieties of maize plants, *i.e.*, S.C 10, S.C 129 and Th 324 were studied.

Nitrogen fertilizer was applied by rates of 100%, 50% and 25% of recommended doses (RN), while organic compost (OC) and elemental S were added by rates of 15 m^3/fed and 200 kg/fed, respectively.

The results showed that pronounced decreases for soil ECe values in rhizosphere maize plants, due to many *Azospirillum* strains that produce several phytohormones such as indole acetic acid, cytokinins and organic acid which had an effect to reduce the salinity stress in rhizosphere of growing plants. Since the rate of depression for EC_e were 34.8, 29.3 and 31.1% for S.C 10, S.C 129 and Th 324, respectively compared to control. Moreover, pH values reached 7.82, 7.81 and 7.62 for S.C 10, S.C 129 and Th 324, respectively. These results may be due to the active microorganisms, biological activity in particular and organic acid production in rhizosphere of growing plants and presence of sulphur element.

In general, all characterizes of maize growth and yields for all maize varieties recorded maximum values with the treatment OC + Bio + S + 25% RN. The maximum grain yields were 3.57, 3.52 and 3.58 ton/fed for S.C 10, S.C 129 and Th 324, respectively.

With respect to rate of germination and grain quality, *i.e.*, N,P,K %, Fe, Zn and Mn (ug/g^{-1}) and crude protein % (since protein recorded to 10.17, 10.37 and 10.14 for S.C 10, S.C 129 and Th 324, respectively) the highest values were recorded under treatment by OC + Bio + S + 25% RN.

For oil (%) data show that there is no significant difference between the treatments, but in the case of carbohydrate percentage data show that a slight decrease for all treatments than the control for the three maize varieties.

It could be concluded that organic compost+ N_2-fixer strains (PGPR) +mineral sulphur +low amount of mineral nitrogen (25% RN) gave the highest maize yield and quality. Also maize varieties S.C 10 and Th 324 were more tolerance to soil salinity than S.C 129.

Keywords: Saline soil, Bio-fertilizer, Mineral nitrogen, Organic compost, Sulphur, Maize plant.

Soil salinity is one of the important factors, which affected on growth and yield of most crops. Application of save materials such as organic and bio- fertilizers which can be used to reduce the adverse effect of soil salinity on plant growth must be taken into consideration. In this concern, (El-Fayoumy & Ramadan, 2002) studied the effect of mineral nitrogen fertilizer levels or bio-fertilization on soil salinity and salt distribution. They reported that the degrees of soil salinity were slightly affected. Also (Shaban & Omar, 2006) reported that N_2-fixer strains in combination with 150 kg Urea/fed gave the highest maize yield and showed the effective role of PGPR under saline condition. Adding organic manures is considered as an improving treatment for soil fertility and hence its contents of N, P, K beside micronutrients, which is consequently reflected on plant growth and yield (Ismaiel, 2002 and Mahdy, 2003). One of N-fixers, plant growth promoting rhizobacteria (PGPR) were recommended by (Noel *et al.*, 1996) which can actively colonize plant roots and improved growth and yield by direct and indirect mechanisms. Bio-fertilizers especially N-fixing bacteria, which suggested reducing the used mineral fertilizer quantities and producing clean and healthy crops (Mantripukhri, 2006).

Maize is one of the important cereal crops in Egypt, which needs high rate of N-application, reached to 300 kg Urea/fed in normal soils (Nofal & Hinar, 2003). These large quantities of the mineral N-fertilizers especially in the case of salt affected soil cause environmental pollution through drainage water and other N-contaminated water (Mantripukhri, 2006). Abbas *et al.* (2006) reported that bio-fertilization through inoculation with *Azotobacter* or *Azospirillum* as well as applying organic manure could minimize the dose of mineral N required to be applied, which is a profitable form the economic point of view, and effective in reducing pollution of soil with N. George (2008) added that, if large quantities of low nitrogen organic matter are incorporated into soil, legumes will fix nitrogen more effectively and increase their total dry matter production.

Ceccotti (1996) recorded that sulphur plays an important role in the primary and secondary plant metabolism as a component of protein, glucosinolates and other compounds that related to several parameter determining the nutritive

quality of crops. Lal *et al.* (1995) added that sulphur is an integral part of acylcoenzyme A that helps synthesis of more fatty acid.

The present work aimed to study the effect of applied some materials such as organic, bio-fertilizers, sulphur and their combination on the productivity and grains quality of maize grown on saline soil.

Material and Methods

A field experiment was carried out at Sahl El-Tina, Gelbana Village No 7, Port Said Governorate for two successive summer seasons, using as indicator crops three varieties of maize (hybrids S.C 10, S.C 129 and Th 324).

The soil was irrigated from El-Salam Canal (Nile water + drainage water). Some physical and chemical characteristics of the soil are presented in Table 1 which, were determined according to Klute (1986) and Page *et al.* (1982). The experimental design was a combined split plots design with three replicates. The main plots were for maize verities and sub plots were for the treatments. The plot area was 10.5 m^2 (3m width and 3.5 m length).

TABLE 1. Some physical and chemical properties of the investigated soil.

Soil characteristics	Values
Pratical size distribution (%)	
Coarse sand	21.4
Fine sand	54.6
Silt	9.7
Clay	14.3
Textural class	sandy clay
Soil chemical analysis:	
pH (1 : 2.5 soil suspension)	8.25
ESP	15.6
Carbonate (%)	7.7
Organic matter (%)	0.47
EC_e ds/m (soil paste)	10.69
Soluble cations (me/l)	
Ca^{++}	8.49
Mg^{++}	13.72
Na^{+}	79
K^{+}	0.59
Soluble anions (me/L)	
HCO^{-}_3	8.73
$CO^{=}_3$	-
Cl^{-}	62
$SO^{=}_4$	31.07
Available N (ug/g^{-1})	18
Available P (ug/g^{-1})	4.5
Available K ((ug/g^{-1})	218

Studied treatments were as follows:

1. Control recommended dose from mineral- N i.e. 120 kg/fed (100% RN) that applied in the form of Urea (46% N).
2. Organic compost (OC) $15m^3$/fed+ 50% RN.
3. Bio-fertilizer (Bio) *Azospirillum barastlense* no 40 (salt tolerant Plant Growth Promoting Rhizobacteria PGPR) + 50% RN.
4. Elemental sulphur (S) 200 kg/fed+ 50% RN.
5. Organic compost (OC) + S + 25% RN.
6. Bio-fertilizer (Bio) + Sulphur (S) + 25% RN.
7. Organic compost (OC) + Bio + 25% RN.
8. Organic compost (OC) + Bio + Sulphur(S) + 25% RN.

Organic compost was prepared from the residues of maize crop and its chemical components are shown in Table 2. Elemental sulphur and organic compost (OC) were added to the soil before cultivation. Grains were inoculated with Azospirillum barastlense no 40 (salt tolerant PGPR).The plots were ploughed twice in two ways and received super phosphate (15.5% P_2O_5) at the rate of 200 kg/fed during soil preparation for cultivation. Potassium sulphate (48%K_2O) was added in equal two doses at rate of 100 kg/fed, during the growing period (after 15 and 40 days from sowing). Nitrogen fertilizer was applied in two equal doses, during the growing periods (after 15 and 40 days from sowing).

TABLE 2. Chemical analysis of the compost.

pH 1:2.5	EC_e (ds/m)	C/N	N	P	K	Fe	Zn
			%			ug/g^{-1}	
7.25	5.76	22.5	1.83	0.88	2.23	25.9	28.6

For two seasons, the morphological measurements, *i.e.*, plant height (cm), leaf area (cm^2), ear height (cm), ear diameter (mm) using planymeter, number of rows/ear, number of grains/rows, ear length, number of ears/plant and weight of grains/ear, for maize plants were measured before harvest by about 15 days. Moreover, after harvest, stover, 100-grain weight, grain yield and quality were determined. Vigor test was conducted at Seed Technology Research Dept., Agriculture Research Center (ARC) that included :

a) Rate of germination: Grains were incubated in moist paper at 25°C for 8 days. Normal seeding were counted according to international rules I.S.T.A. (1993) and expressed as germination percentage. Seeding vigor was assessed by measuring radical length, shoot length and its dry matter.

b) Electrical conductivity: The electrical conductivity of leachiest was determined according to procedure described by A.O.S.A (1983). Four samples of 50 seeds from each sub plot were weighted and placed into flask with 250 ml of distilled water and held at 25°C after 25hr. The electrical conductivity was determined using the conductivity meter. The mean values were expressed in µs.

$cm^{-1}.g^{-1}$. The conductivity per gram of seed weight for each sub-sample was calculated by the following formula

$$\frac{\text{Conductivity (µs/cm) for each flask}}{\text{Weight (g) of seed sample}} = \mu s.cm^{-1}.g^{-1}$$

Grains were analyzes for N, P, K, Fe, Mn, and Zn (Cottenie *et al.*, 1982). Oil (A.O.A.C, 1975).Total carbohydrates (A.O.A.C 2000) and protein content calculated by multiplying N content with factor 6.25.

Representative soil samples of rhizosphere for grown maize were collected, at the depth (0-30) cm from each plot after harvesting. Air-dried and analyzed for electrical conductivity EC_e ds/m of soil paste and pH in (1: 2.5) soil: water suspension. The obtained data (average of two seasons), were statistically analyzed according to S.A.S (2001).

Results and Discussion

Soil salinity (EC_e) and soil pH

Concerning the effect of the treatments on soil salinity, in the rhizosphere of grown maize, data in Table 3 revealed that the value, of soil salinity EC_e (ds/ m) decreased in all soil treatments in compare with the control treatment .The effect is more pronounced in the soils, treated by Bio+S+25 % RN, OC+Bio+25 % RN and OC + Bio + S + 25 % RN. The lowest EC_e values were recorded with the treatments OC + Bio + S + 25 % RN by rate of depression (34.8, 29.3 and 31.1%) than control for (S.C 10, S.C 129 and Th 324), respectively.

This trend can be interpreted to many Azospirillum strains that produce several phytohormones such as indole acetic acid and cytokinins (Omar *et al.*, 1993) and organic acid (El -Fayoumy & Ramadan, 2002) which had an effect to reduce the salinity stress in rhizosphere of growing plants. In addition, Bacilio *et al.* (2003) reported that under high NaCl concentration, inoculation with Azospirillum lipoferum reduced the deleterious effect of NaCl. Ashmaye *et al.* (2008) recorded that the combination treatments of Bio +sulphur, Bio+organic and Bio+organic+sulphur+85kg N/fed, resulted in a decrease of salt in soil.

Data presented in Table 3 also indicated that all of the experimental treatments have a slight decrease effect on soil pH in the rhizosphere of grown maize compared with pH of the control treatment. The effect is more pronounced in the soil treated with OC+S+25 % RN, Bio+S+25 % RN, OC+Bio+25 % RN and OC + Bio + S + 25% RN. The highest decreasing in pH value for (S.C 10, S.C 129 and Th 324) were achieved by treating the soil by OC + Bio + S + 25% RN, by rate of depression (3.45, 3.20 and 6.1%), respectively than control. This result may be due to the active microorganisms, biological activity in particular and organic acid production and presence of sulphur element.

TABLE 3. EC_e and pH of the soil sample collected from rhizosphere of grown maize after harvest*.

Treatment	pH			EC_e ds/m		
	Varieties			Varieties		
	S.C (10)	S.C (129)	Th (324)	S.C (10)	S.C (129)	Th (324)
Control 100% RN	8.09	8.06	8.09	8.68	8.30	8.42
OC+50 % RN	8.05	8.02	8.05	7.34	7.12	7.12
Bio+50% RN	8.04	8.01	7.92	7.02	7.11	7.03
S+50% RN	8.00	7.96	7.91	7.01	7.12	7.05
OC+S+25% RN	7.88	7.86	7.63	7.00	7.10	7.00
Bio+S+25% RN	7.86	7.84	7.62	6.45	6.44	6.43
OC+Bio+25% RN	7.84	7.82	7.61	6.44	6.43	6.42
OC+Bio+S+25% (RN)	7.82	7.81	7.60	6.44	6.42	6.42

*Average of two seasons.

Growth characters

Data presented in Table 4 revealed the effects of different amendment on growth characters of maize which inoculated or uninoculated treatments, increased (than control) due to application of organic compost, bio-fertilizers, and sulphur or their combination. The increases was progressive with the rate of treatments whether in its organic, bio-fertilizers or the sulphur, or the OC+S+25% RN or the Bio+S+25% RN or the OC + Bio + 25% RN or in the

TABLE 4. Effect of applied organic and bio-fertilizers on some morphological measurements of maize plants*.

Treatment	Leaf area(cm^2)			Plant height(cm)			Ear height(cm)			Ear length(cm)		
	Varieties			Varieties			Varieties			Varieties		
	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324
Control 100% RN	314.3	371.2	392.9	199.3	204.7	204.0	80.0	94.0	97.0	20.3	19.2	18.7
OC+50 % RN	406.4	418.4	422.1	206.7	205.7	208.7	93.0	104.3	102.0	20.3	20.0	19.2
Bio+50% RN	456.3	438.0	448.7	214.6	210.0	219.0	95.7	106.0	110.0	20.6	20.3	20.3
S+50% RN	534.0	454.1	458.2	216.0	212.0	224.7	96.0	107.3	111.7	21.0	20.3	20.7
OC+S+25% RN	573.3	459.2	521.1	217.0	223.0	229.3	106.0	113.3	116.3	21.0	20.7	21.0
Bio+S+25% RN	588.1	471.4	522.3	217.4	230.0	239.0	100	119.0	119.7	21.0	21.0	21.4
OC+Bio+25% RN	588.7	474.9	580.2	283.2	231.0	243.0	110	119.1	119.9	21.1	21.0	22.2
OC+Bio+S+25% RN	590.1	487.3	598.1	288.0	235.0	243.4	113.3	119.4	121.0	21.1	21.0	22.7
L.S.D $_{0.05}$ for treatment(T)	51.12			N.S			N.S			0.43		
L.S.D $_{0.05}$ for varieties(V)	N.S			21.42			14.12			1.4		
L.S.D $_{0.05}$ for (T x V)	N.S			N.S			N.S			2.42		
C.V	8.41			9.11			10.50			1.68		

*Average of two seasons.

TABLE 4. Condt.

Treatment	Ear diameter (m m)			No of rows /ear			No of grains on row / ear			Weight of grains/ ear (g)		
	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324
Control 100% RN	30 9	30 7	30 9	12 0	12.0	12 0	40.7	34.0	34.0	158.3	92.2	95 4
OC+50 % RN	40.3	30 8	40 3	12 0	12.0	12.0	43.3	36 0	36 7	175 6	100 0	106 1
Bio+50% RN	40.4	40.0	40 4	12.3	12 0	12.5	45 3	40.3	36.3	185.9	113.5	110 3
S+50% RN	40 4	40.1	40 3	12 6	12.5	12.6	46.3	41 3	43.0	183 5	132.5	124.6
OC+S+25% RN	40 5	40.2	40.3	12 6	12.6	12 6	47.0	44.0	44.0	188 9	162.4	149 4
Bio+S+25% RN	40 6	40.4	40.6	12.7	12.6	12.7	48.0	46.0	45.0	193.9	165 0	157 8
OC+Bio+25% RN	40 6	40 4	40.6	12 6	12.7	12.5	48.3	46 0	46.0	203 8	173.8	175 6
OC+Bio+S+25% RN	40 7	40.4	40 7	12.7	12 7	12.7	49 2	49 0	48 0	223 1	176 3	177.3
L.S.D $_{0.05}$ for treatment(T)	0.115			0 39			0.244			13.20		
L S D $_{0.05}$ for varieties(V)	0.14			0.73			2 26			16.21		
L S D $_{0.05}$ for (T x V)	0.24			1 27			3 91			28 1		
C.V	2.12			2.34			0.431			6.59		

* Average of two seasons.

OC+Bio+S+25%RN. Data also indicate that the maximum values for all maize morphological measurement were obtained under treatment the soil by OC+Bio+S+25% RN. The relative increases over control, for three varieties (S.C 10, S.C129 and Th 324) reached to, (87.7,31.3 and 52.2%) leaf area (cm^2), (44.5,14.8 and 19.3%) plant height (cm), (41.6,27.0 and 24.7%) ear height (cm), (9.3,9.3 and 21.4%) ear length(cm) ,(31.7,31.6 and 31.7%) ear diameter (mm), (20.8, 44.1 and 41.1%) no of grains ,on row / ear and (40.9, 91.2 and 85.8%) weight of grains/ear (g), respectively. This is because organic compost improves soil fertility, which reflected on plant growth and characters and bio-fertilizers, assists maize plants to tolerant soil salinity. In the other hand combining the bio-fertilizer with organic compost, sulphur and chemical fertilizers led to a marked increases in growth characters, this is because nitrogen is essentially for making the protoplasm and hence produce new cells and new leaves of plant and consequently led to a larger surface available for photosynthesis and increase dry matter accumulation.

In this connection Milic & Saric (1988); Atta-Allah (1998); Badran (2000) and Griesh *et al.* (2001) recorded that biofertilizer treatments, significantly increased plant height, leaf area, ear height, ear length and ear diameter .Data in Table 4 also show that there is no significant affect, for number of rows / ear, which is rarely influenced by cultural practices, compared with other characters. This mainly because it is genetically controlled. These data are in harmony with those of Sayed *et al.* (2003) and El-Douby (2002) which recorded that nitrogen fertilizer up to 120 kg N/fed did not show any significant affect on number of rows/ear in two seasons.

The statistical analysis for data indicated that all maize morphological measurement were significantly affected by treatment except that leaf area for (V) and (V x T), plant height for (T) and (V x T), and ear height for (T) and (V x T).

Yield and yield components of maize

Results in Table 5 indicated that maize grains (ton/fed), 100 grain (g) and stover (ton/fed) were affected by fertilizer treatments in all maize varieties. Generally, yield value of any treatments was higher than control or RN 100%, for three maize varieties. The relative increases for (S.C 10, S.C129 and Th 324) were (78.5, 76.0 and 64.9%) for grains ton / fed, (45.7, 40.7 and 41.9 %) for weight of 100 grain and (48.7, 48.6 and 53.7%) for stover ton/fed, respectively were noticed with the treatment OC + Bio + S + 25% RN. Data also indicated that S.C 10 and Th 324 varieties were more efficiency to tolerance for soil salinity than S.C 129 variety.

The statistical analysis for data in Tables 5 indicated that maize yield was significantly affected by treatment. Thus, the significant favorable effect of the combination between nitrogen fertilizer doses, organic, bio-fertilizers and sulphur may assisted the plant to tolerance soil salinity .These results are in harmony with Shaban & Omar (2006). Sahar (2006) which recorded that maize grains and straw yield and yield quality increased as the mineral nitrogen fertilization level increase up to 150 kg/fed but nitrogen use efficiency increase up to 120 kg/fed and then decline. Using organic and / or biological fertilization inoculation enhances and promotes nitrogen use efficiency, so that organic and / or inoculation could partially substitute the mineral N fertilization and compensate the deficiency in mineral N fertilization. The organic N- fertilization could compensate 50 kg from the mineral N while biological N fertilization compensates 10 kg N- fertilization.

TABLE 5. Effect of applied organic and bio-fertilizers on maize yield*.

Treatment	Grains (ton/ fed)			Weight of 100 grain (g)			Stover (ton/ fed)		
	Varieties			Varieties			Varieties		
	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324
Control 100% RN	2.00	2.00	2.17	27.8	26.3	26.0	4.1	3.7	4.10
OC+50 % RN	2.50	2.35	2.54	33.5	30.6	30.5	5.1	4.5	4.70
Bio+50% RN	2.98	2.81	2.86	35.8	33.0	31.6	5.3	4.6	4.90
S+50% RN	2.99	3.16	3.23	30.2	33.7	33.5	5.5	4.7	5.11
OC+S+25% RN	3.24	3.46	3.54	39.5	33.8	35.8	5.8	4.9	5.30
Bio+S+25% RN	3.52	3.49	3.54	40.1	38.4	36.8	5.8	4.8	5.40
OC+Bio+25% RN	3.55	3.51	3.56	40.3	37.0	36.7	6.0	5.1	6.01
OC+Bio+S+25% RN	3.57	3.52	3.58	40.5	37.4	36.9	6.1	5.5	6.30
L.S.D$_{0.05}$ for treatment(T)	0.095			0.24			0.13		
L.S.D $_{0.05}$ for varieties(V)	1.26			0.83			0.17		
L.S.D $_{0.05}$ for (TxV)	0.80			1.44			1.32		
C.V	10.06			2.18			13.26		

*Average of two seasons.

Grains quality

***Vigor test*

Data in Table 6 show the effect of experimental treatments, on shoot length (cm), radical length (cm), rate of germination percentage and EC value. Generally, shoot length (cm), radical length (cm) ,rate of germination % and EC value for, three varieties ,of maize (S.C10 ,S.C129 and Th 324) recorded, maximum value with the treatment, by OC + Bio + S + 25% RN. The rate of increases over control, were (79.7, 95.0 and 90.9%) for shoot length (cm), (63.0, 66.8 and 65.9%) for radical length (cm) and (25.4, 15.4 and 22.5%) for rate of germination, respectively. For EC values data show that EC decreased in all treatment than control.

TABLE 6. Vigor test as affected by applied organic and bio-fertilizer*.

Treatment	Shoot length (cm)			Radical length (cm)			Rate of germination %			EC		
	Varieties			Varieties			Varieties			Varieties		
	S C 10	S.C 129	Th 324	S C 10	S.C 129	Th 324	S.C 10	S.C 129	Th 324	S C 10	S.C 129	Th 324
Control 100% RN	10 80	11 47	11.17	7 07	7.87	6.90	72 00	81 70	74.00	5.46	5.00	5.15
OC+50 % RN	14.00	14.82	16.77	7.67	7.88	7.21	74.00	83.30	75.00	3.58	3 54	3 54
Bio+50% RN	14.03	15 98	16 60	8.90	9 40	8.13	76.00	86.00	83.30	4.74	5.20	5.20
S+50% RN	14.01	18.42	15.53	10.23	9.53	9 18	82.00	86.00	86.00	4.69	4.30	3 30
OC+S+25% RN	17.97	19.90	16.92	10 61	10.63	9.44	83.30	87.30	86.30	4.74	4.20	4 20
Bio+S+25% RN	18 53	19 98	19.99	10.80	11 77	10.78	83.30	88.00	86.40	4.69	2 50	4.30
OC+Bio+25% RN	19.22	22 30	20 89	11 51	12.20	11 02	88 33	93 30	88.00	4 08	3 30	4 00
OC+Bio+S+25% RN	19 41	22 37	21 33	11.53	13.13	11 45	90.33	94 33	90.70	4.09	4.30	4.02
L S $D_{0.05}$ for treatment(T)	1 26			0.622			2 62			1.12		
L S D $_{0.05}$ for varieties(V)	1.11			0.81			5 30			1.35		
L S.D $_{0.05}$ for (TxV)	1.92			1.40			9.18			1 60		
C.V	5 97			5.23			2.47			3 02		

*Average of two seasons.

Thus, the significant mineral nitrogen, bio–fertilizer, organic matter and sulphur may be assisting based on nutrient availability, vital enzymes and hormonal stimulating effect on plant growth or increasing the photosynthetic activity. The statistical analysis for data indicated that shoot length, radical length, rate of germination and EC value were significantly affected by treatments.

Macro and micronutrients

Data in Table 7 show that, maize grains contents of macro and micronutrient. Data show that, maize grains contents of N, P and K percentage, and maize grains content of Fe, Mn and Zn (ug/g^{-1}). In general, grains contents of N, P, K (%) and Fe, Mn, Zn (ug/g^{-1}) increased under any treatment in comparing with the lowest value of the control. The highest values for the (S.C 10, S.C129 and Th

Th 324) were (1.62, 1.66 and 1.65) %, (0.28, 0.27 and 0.26) % and (2.34, 2.22 and 2.30) % for N, P and K, respectively. While, values were (85.1, 84.2 and 84.4 ug/g^{-1}), (65.1, 64.2 and 66.0 ug/g^{-1}) and (48.9, 49.0 and 48.7 ug/g^{-1}) for Fe, Mn and Zn, respectively, these values which recorded under treatment by OC + Bio + S + 25% RN.

The statistical analysis for data indicated that maize grains content of macro and micronutrient were significantly affected by treatment. In this connection, Mashram & Shende (1982) recorded that total N uptake by maize after inoculation with Azotobacter combined with moderate applications of N fertilizer and FYM increased significantly and results a higher N concentration in grains and straw along with a higher yield (Milic & Saric, 1988). Anita *et al.* (1998) observed that the effects of inoculation on plant growth may in part be due to the stimulation of already existing plant growth –promoting rhizobacteria in and around roots. Bacterial inoculation also resulted in significantly higher values for nitrogen and phosphorus content of plant components.

Malik *et al.* (2000) added that organic fertilization improved the soil fertility in terms of higher amount of total N. Shaban & Omar (2006) recorded that, the inoculation under mineral nitrogen fertilizer doses gave much increases in N, P and K contents in grains and stover. Ashmaye *et al.* (2008) recorded that the combination treatments of organic farm, bio-fertilizers, sulphur and 85 kg N/fed resulted in an increases in the available N, P and K and the available micronutrients Fe, Mn, Zn and Cu concentrations for maize grains triple hybrid 310.

Oil, carbohydrate and protein

Data in Table 8 represent maize grains contents of oil, carbohydrate and protein percentage. In general, grains contents of protein percentage under any treatment increased in comparing with the lowest values of the control. The highest crude protein were (10.17, 10.37 and 10.14%) for (S.C 10, S.C129 and Th 324), these values were achieved, under treatment by OC + Bio + S + 25 % RN Mohamed & El–Aref (1999) reported that application of 20 kg N + $20m^3$ FYM produced the highest, grains and protein yields.Also,data show that, a slight increases of oil (%) for all treatment over control, and there is no significant, difference in oil % between the treatments. This mainly, because it is genetically controlled. Jellum *et al.* (1973) found that oil percentage of maize grain not affected by nitrogen fertilizer.

For the grains content of carbohydrate percentage data show that a slight decrease for all treatment than the control for three maize verities. Shadia (2007) added that the application of anhydrous ammonia as well as compost significantly increased the crude protein. However, the carbohydrates concentration was decrease in both seasons.

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تأثير إضافة الاسمده العضوية والحيوية على إنتاجية وكفاءة بذور الذرة النامية في ارض ملحية

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أجريت تجربه حقلية بسهل الطينة قرية جلبانه رقم (٧) – محافظة بورسعيد موسمين صيفي لدراسة تأثير بعض معاملات التسميد العضوي والحيوي على نبات الذرة أصناف هجين فردي (١٠، ١٢٩) وهجين ثلاثي (٣٢٤) وذلك بالإحلال الجزئي لسماد النيتروجين المعدني بالمادة العضوية (كمبوست) وتلقيح حبوب الذرة بالبكتريا (أزوسبيريليم برازيلنيز PGPR) والكبريت المعدني مع إضافة معدل منخفض من النيتروجين المعدني والتداخل بينهم علي إنتاجية محصول الذرة وكفاءة البذور.

وقد تم إضافة سماد النيتروجين المعدني بمعدلات ١٠٠٪ ، ٥٠٪ ، ٢٥٪ (يوريا ٤٦٪ نيتروجين) من الجرعة السمادية الموصى بها بينما تم إضافة المادة العضوية (كمبوست) والكبريت المعدني بمعدل ١٥م٣ / فدان و٢٠٠ كجم / فدان على التوالي.

وقد أظهرت النتائج إن هناك انخفاض في درجة الملوحة في منطقة انتشار الجذور لنبات الذرة حيث وصل معدل الانخفاض في درجة الملوحة إلي (٣٤,٨، ٢٩,٣ ، ٣١,١ ٪) لأصناف (١٠، ١٢٩، ٣٢٤) على التوالي بالمقارنة بالكنترول ويرجع ذلك إلى التسميد الحيوي بالبكتريا الذي ينتج phytohormones مثل indole acetic acid ، organic acid cytokinins التي تعمل بدورها على خفض الملوحة في منطقة انتشار جذور النبات.

ولوحظ أيضا انخفاض في رقم الحموضة حيث وصل رقم الحموضة pH إلي (٧,٨٢، ٧,٨١، ٧,٦٢) لأصناف (١٠، ١٢٩، ٣٢٤) على التوالي، ويرجع ذلك إلى الميكرواورجنزم والنشاط البيولوجي والأحماض العضوية الناتجة وكذلك وجود الكبريت المعدني.

وقد أوضحت النتائج تأثر جميع صفات النمو لأصناف الذرة تحت الدراسة وسجلت أعلى قيمة عند المعاملة بالمادة العضوية (كمبوست) + البكتريا المثبتة للأزوت الجوى (PGPR) + الكبريت المعدني + ٢٥٪ من الجرعة الموصي بها (نيتروجين معدني) وكانت أعلى قيم لمحصول الحبوب ٣,٥٧، ٣,٥٢ ، ٣,٥٨طن/فدان لأصناف (١٠، ١٢٩ ، ٣٢٤) على التوالي٠

ولوحظ إن أعلى تركيز في حبوب الذرة من النيتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز وكذلك نسبة البروتين حيث وصلت نسبة البروتين إلى (١٠,١٧، ١٠,٣٧، ١٠,١٤٪) لأصناف (١٠، ١٢٩، ٣٢٤) علي التوالي عند المعاملة بالمادة العضوية(كمبوست) + البكتريا المثبتة للأزوت الجوى + الكبريت المعدني + ٢٥٪ نيتروجين معدني٠ ولم يظهر أي تأثير في نسبة الزيت بين المعاملات المختلفة، بينما كان هناك انخفاض قليل في نسبة الكربوهيدرات بين المعاملات المختلفة لأصناف الذرة تحت الدراسة ٠

وبصفة عامة فإن إضافة المادة العضوية + البكتريا المثبتة للأزوت الجوى (PGPR) + الكبريت المعدني +معدل منخفض من النيتروجين المعدني (٢٥٪ من الجرعة الموصى بها) أعطت أعلى إنتاجية وكفاءة لمحصول الذرة وكذلك اعلي نسبة إنبات لحبوب الذرة وكان صنف الذرة هجين فردي ١٠وهجين ثلاثي ٣٢٤ أكثر تحمل للملوحة من هجين فردي ١٢٩٠