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Improvement of Maize Yield and Some Soil Properties by Using Nitrogen Mineral and PGPR Group Fertilization in Newlv Cultivated Saline Soils

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A FIELD EXPERIMENT was carried out on the summer growing season of 2006 at Sahl El-Tina plane. This work aimed to study the possibility of improvement the new cultivated soils at Galbana village of Sahl El-Tina plane with area reach about area 40000 fedans. This area is irrigated from El-Salam canal (Nile water -agriculture drainage water), and decrease mineral nitrogen fertilizer by using bio-fertilization, reduce the environments pollution. Maize grains (cv. Triple hybrid 310) were inoculated by *Azospirillum barasilense* strain (salt tolerant PGPR strain) in the half of plots with N_2- fixer bacteria through coating the grains with bacterial carrier material. On the other hand half plots were left without inoculation. Mineral nitrogen fertilizer was applied on three equal doses at the rate of 100, 150 or 200 urea 46% N kg/fed. in sub treatments in a split plot design.

The results showed that pronounced decreases in pH and EC values, were occurred due to some improving in soil properties. Availability of N, P and K in the soil were increased as compared to the initial soil and consequently increased in the grains and stover of maize. Yields of grains and stover as well as weight of 100 grains gave high significant yield in the presence of 92 kg N/fed combined with inoculation treatment. It could be noticed also that the inoculation with PGPR group accompanied with mineral nitrogen levels up to 60 to 70 % of the recommended doses of mineral nitrogen raised their efficiencies . Finally, it could be concluded that N_2-fixer strains in combination with 150 kg urea/fed gave the highest maize yield and showed the effective role of PGOR under saline condition.

Keyword: Sandy clay saline soil , Microbial N-fixing, Urea , Maize.

Under salinity condition, the most problem facing agricultural production in irrigated arid and semi arid areas is how to prepare a suitable root zone. Fertilization plays an important role in promoting plants to tolerate salt stress and toxicity (Ghoulam *et al.*, 2002). Maize as one of the important creal crops in Egypt needs high rate of N-application reached to 300 kg urea /fed in normal soils (Nofal, 2003) . These large quantities of the mineral N- fertilizers especially in the salt affected soil cause environmental pollution through drainage water and other N- contaminated water (Mantripukhri, 2006).

Bio-fertilizers especially these N- fixing bacteria were suggested to reduce the used mineral fertilizer quantities and produce clean and healthy crops (Mantripukhri, 2006). 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 . The effectiveness of the plants rizosphere colonization by PGPR depends on many factors in the agro-ecosystem including soil type, climate conditions and fertilization (Dobbelaere *et al.*, 2001). In addition, soil pH and moisture are crucial for ultimate attachment and spread of the microbes (Burr *et al.*, 1978).

Concerning the effect of mineral nitrogen fertilizer levels or bio-fertilization on soil salinity and salt distribution, the degrees of soil salinity were slightly affected (El-Fayoumy & Ramadan 2002). Moreover, Rashed (2006) reported that the soil content of available N- increased as the level of mineral N fertilization increased . He also found that biological N- fertilization increased the soil content of available N and P by the lowest or even without mineral N- fertilization, but declined the soil content of available N and P at the highest levels of mineral N – fertilization.

From other wise, healthy plants having strong root systems adsorbe some salts which associate with leaching programme in reducing soil salinity (Shaban & Helmy , 2006). Modifying the irrigation intervals from 15 to 8 days avoids the hazardous effect of osmotic potential of soil solution. On the other hand, partial substitution N mineral by N- Bio- fixation minimize the hazardous effect of chemical pollution, in addition to decrease the costs. (Shaban & Helmy , 2006).

The aim of this study was to evaluate the effect of PGPR in combination with different mineral N rates of application on: a) soil pH, EC, b) available macronutrients in soil, c) plant part contents of macronutrients and d) maize yield in such area of Sahl El-Tina irrigated with 1:1 fresh – drainage mixture water (El-Salam canal).

Materail and Methods

A filed experiment was conducted on salt affected sandy clay soil at Gelbana town of Sahl El-Tina plane during the summer growing season of, 2006. Upper 30 cm layer soil samples were taken before planting as shown in Table 1 and after harvest of maize in Table 2. Soil samples were air dried , ground, sieved through a 2 mm sieve and kept through dry containers for analysis, according to the methods described by Black (1965).

Grains of maize (Zea *mays* L) cultivar Triple hybrid 310 supplied from Maize Department Filed Crop Res Inst. ARC, were sown on the 12th of May 2006, in the half number of plots without any inoculation . In the another plots, grains were inoculated with *Azospirillum brasilense No 40* (Salt Tolerant PGPR) by coating grains with the gum media carrying the bacteria strain on the same day of sowing. The inoculated grain plots were soil applied with liquid bacteria strain three times after 21, 42 and 62 days of planting following Omar *et al.* (2000).

Mineral nitrogen fertilizer was applied in a rate of 100, 150 or 200 kg urea (46% N) /fed. with three replicates in a split plot design. Nitrogen rate was added in three equal doses after 21, 42 and 62 days of planting. Calcium superphosphate (15.5% P_2O_5) was added in a rate of 15.5 kg P_2O_5 /fed during soil preparation while potassium sulphate (48% K_2O) in a rate of 100 kg/fed was added on three doses after 21, 42 and 62 days of planting to conserve it from leaching due to soil leaching requirement . These mineral fertilizer rates were the recommended by Egyptian Ministry of Agriculture bulletin (2004).

In addition to the primary field preparation such as soil surface leveling by leaser technique , sub soiling and drains establishment every 10 m, irrigation was done according to soil leaching requirement calculated till crop maturity every 8 days which was stopped on the 17^{th} September, 2006 .

Maize ears were harvested on the 10^{th} October, 2006 where ears of each plot were counted and weighed.

On the day before harvesting, three plants of each plot were collected as a plant sample which were washed, divided into stems, leaves including ear husks and ears and weighed. A suitable part of each sample stems or leaves was taken, weighed, 75° oven dried and weighed. Ears left 8 days to reach its normal air dryness to separate their grains (above 11% moisture). Grains and cobs were weighed, 100 grain weight recorded, suitable part of each grains and cobs were weighed 75° oven dried and chemical analyzed to determine their contents of macronutrients according to Chapman & Pratt (1961) .

The obtained data were statistically analyzed according to Sndecore & Cochran (1982).

Soil analysis

The following soil and plant analysis were soil performed: Particle size distribution was determined by the Pipette method, without $CaCO_3$ removal, (Piper, 1950) and $CaCO_3$ content was determined by the Calcimeter (Black, 1965). Soil organic matter was assayed by the methods described by Black, (1965).Soil pH was measured using pH meter in soil: water extract (1:2.5) described by Jackson (1967). Total soluble salt (EC) were measured in soil paste (Jackson, 1967) .Available N was extracted from soil using 2N KCl solution and measured according to the modified Kjeldahel method (Black, 1965). Available P was extracted by 0.5 N sodium-bicarbonate, and determined colorimetrically according to Olsen's method (Jackson, 1967). Available K was determined using the Flame-Photometer. Data in Tables 1-3 show that physical and chemical soil before and after maize planting.

TABLE 1. Physical and chemical properties before planting.

Course sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Textural class	O.M (%)	$CaCO_3$ (%)
21.4	54.6	9.7	14.3	Sandy clay	0.48	7.9

pH (1:2.5)	EC dSm^{-1}	Cations (meq/l)				Anins (meq/l)			
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO^{-}_3	HCO^{-}_3	Cl^{-}	SO^{-}_4
8.45	6.6	8.6	12.4	44	1.40	nil	6.2	31	29.2

Macro element availabilities (mg/kg)		
N	P	K
43.0	3.8	189.0

Plant analysis

Nitrogen was determined by the Kjeldahel method (Chapman & Pratt, 1961). phosphorus was determined colorimetrically and potassium was determined using Flame-Photometer, according to Jackson (1967).

Enzymatic activities

Rhizosphere to soils samples were taken, after two months of sowing to measure the activities of dehydrogenase according to Shujins (1973) and Nitrogenase (N_2. ase) assayed using GC, model Hp 6890 according to the method described by Schollhorn & Burris (1967).

Results and Disscusion

Some soil chemical properties

Soil salinity (ECe)

Concerning the effect of the treatments studies on soil salinity, data in Table 2 revealed that the values of soil salinity EC (dS/m) decreased significantly by increasing mineral nitrogen fertilizer levels. from 46 to 92 kg N and also with bio-fertilizer due to many *Azospirillum strains* produce several phytohormones such as indole actic acid and cytokinins (Omar *et al.*, 1993), which promote plant growth and had an effect to reduce the salinity stress, (El-Rewiny, 1994), who found that the inoculation of rice –grass with *Azospirillum brasilense* under all his studied different levels of salinity resulted in significant improvement in fresh and dry mass of shoots and roots as well as in N_2 content compared with uninoculated plants. Also, Bacilio *et al.* (2003) reported that under high NaCl concentration, inoculation with *Azospirillum lipoferum* reduced the deleterious effect of NaCl. .Therefore, the interaction effect of these two factors was significant on reducing soil salinity from 4.26 to 2.69 dS/m . That highest and lowest values resulted from 46 kg N without inoculation treatment and 92 kg + inoculated one. The corresponding relative decreases were (35.5, 36.4 and 41.0% for 46, 69 and 92 kg N treatments without bio-fertilization and 44.4 , 52.7 and 59.2% , for them with biological treatments on the same respect as compared to soil initial , these results were in aggreement with Abo–Soliman *et al.* (2001).

These results reflected the activity of microorganism to reduce salinity and simultaneously improving characterization of soil structure (increasing drainable porosity and aggregate stability) and consequently enhanced leaching process through irrigation fractions. These results were in agreement with Aziz *et al.* (1998).

Soluble cations and anions

Data in Table 2 showed that there were some closed relationships between soluble Ca^{+2}, Mg^{+2} ,Na^{+} and Cl^{-} , especially in the soil proportion treated with mineral N and bio-fertilizer, the indicate predominant soluble salts were in the descending order; $Na^{+} > Ca^{+2} > Mg^{+2}$ and $SO^{-2}_{4} > Cl^{-} > HCO_{3}^{-}$. Presence of soluble sulphates in soil solution give a safe culture or media for microbial survival and activity (Shaban & Helmy, 2006). These results were in agreement with (Shaban, 2005).

TABLE 2. Chemical properties of soil after maize harvest.

Treatments		pH (1:2.5)	EC (dS/m)	Cations mq/l				Anions mq/l			
mineral N-kg/fed	N-Bio			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO^{-}_{3}	HCO^{-}_{3}	Cl^{-}	SO^{-2}_{3}
46	0	8.24	4.26	5.69	9.48	26.00	1.52	nil	5.30	18.00	19.39
	Bio	8.04	3.67	9.12	6.35	20.00	1.89	nil	4.30	12.00	21.02
	Mean	8.14	3.97	7.41	7.92	23.00	1.71	nil	4.80	15.00	20.21
69	0	8.16	4.20	8.42	7.79	24.00	1.64	nil	4.90	15.00	21.95
	Bio	8.00	3.12	9.45	6.12	14.00	1.93	nil	4.00	10.00	17.50
	Mean	8.08	3.66	8.94	6.96	19.00	1.79	nil	4.50	12.50	19.73
92	0	8.10	3.89	8.69	6.57	22.00	1.68	nil	4.60	14.00	20.34
	Bio	7.98	2.69	9.79	5.78	10.00	1.94	nil	3.40	7.00	15.11
	Mean	8.04	3.29	9.24	6.18	16.00	1.81	nil	4.00	10.50	17.73
Mean	0	8.17	4.12	7.60	7.95	24.00	1.61	nil	4.90	16.00	20.56
	Bio	8.01	3.16	9.45	6.08	15.00	1.92	nil	3.90	10.00	17.88
LSD at 0.05 level	Min -N	0.15	0.38	0.34	0.37	1.44	0.45	nil	1.26	0.47	2.99
	Bio	0.48	0.45	0.25	0.59	1.19	0.37	nil	1.57	2.99	4.19
	Interaction M X Bio	0.21	0.43	0.39	0.42	1.64	0.51	nil	1.44	0.54	3.41

Soil pH

Data presented in Table 2 indicated that the addition of different levels of mineral N and biological fertilization had no significant effect on soil pH. The highest values of soil pH was 8.14 in 46 kg N without bio-fertilizer treatment and the lowest one was 8.04 in 92 kg N with bio-fertilizer treatment. In general, increasing mineral nitrogen levels of application combined with bio-fertilizer led to decrease soil pH but less than the significant limit. This finding is expected to be due to the active microorganism, biological activity in particular and organic acid produced (Mohamed *et al.*, 1998 and El-Fayoumy & Rmadan, 2002).

It could be noticed that the urea application rates did not leave satisfactory residual acid effect to reduce soil pH values significantly . Bio-tretments was also with the same consideration .

Biological measurements

Data presented in Table 3 showed that the effect of different mineral nitrogen fertilizer with bio-fertilizer on Dehydrogenas activity and production of µ moles of H_2 in the rhizosphere of maize root media had a positive effect on increasing the hydrogen moles which react in root zone to form hydrocarbon acid led to decrease soil pH . The values of hydrogen moles in root zones of maize in the treatment of 92 kg N with bio-fertilizer were with about three sholds higher than that in 46 kg N without bio-fertilizer followed by 69 kg-N with bio-fertilizer which was about three sholds also of the 46 kg N un inoculated treatment .

TABLE 3. Effect of bacterial inoculation and mineral nitrogen on enzymatic activities in the rhizosphere soil of maize plants at Sahl El-Tina plane.

Mineral Kg N/fed	Bio. Fert.	D.H.A.* µg TPF/g/hr	µ moles hydrogen/ g/hr	N_2- ase** N moles C_2H_4/ g/hr
46	0	42.5	6.39	1.36
	Bio	117.6	17.60	9.65
	Mean	80.1	11.99	5.51
69	0	22.4	3.37	1.44
	Bio	125.3	18.80	1.08
	Mean	73.9	11.10	1.26
92	0	86.6	13.02	0.69
	Bio	131.7	19.80	16.05
	Mean	109.2	16.41	8.37
0 mean		50.5	7.59	1.16
Bio mean		124.9	19.73	8.93

* D.H.A. = Dehydrogenase activity.

** Nitrogenase activity.

This results in line with the value of soil pH in Table 2. The high activity of Dehydrogenase enzyme and the released carbon dioxide in the rhizosphere cause the formation of carbonic acids and the decrease of the pH of the root zone. Treatments with 92 Kg –N with bio-fertilizer and 69 Kg N plus bio-fertilizer gave 13.02 and 3.37µ moles hydrogen /g/hr, respectively.

This process let to the high rate of the absorption of the nutrient, that couldn't be available at the high pH. This was very useful for the plant growth yield increases (Omar & Ismail, 2002).

Macronutrient N, P and K availabilities in the studied soil

Data in Table 4 showed amounts of the available macronutrients, N, P and K (mg/kg soil) in investigated soil as affected by different N mineral doses with bio-fertilizer. Soil available N increased as the levels of mineral N increased especially with bio-fertilization. Values ranged between 55- 69 mg/kg soil for mineral N fertilizer levels only while they ranged between 71- 79 mg kg soil for these combined with bio-fertilization. Corresponding relative increases reached 28 , 41 , and 60 % over control in case of pure mineral applications and 65, 74 and 83 % compared with soil initial N(43 mg N/kg soil) . This results were in agreement with Mantripukhri (2006) .

Data of available P in soil showed that the amounts of extractable P increased under nitrogen levels and bio-fertilizer application. The corresponding relative increases were 42, 53 and 68 % over control for mineral N levels 46, 69 and 92 kg N, respectively, as compared with initial soil P (3.8 mg P kg soil). The relative percentage increases of soil treated with mineral N- and bio-fertilizers were 81.6, 92.1 and 105.3 % in the same respect over their initial value. These results are in agreement with Marschner (1997) and Rashed (2006).

TABLE 4. NPK content in soil (mg/kg soil) after maize harvest.

Treatments		Available nutrints (mg/kg soil)		
mineral N- kg/fed	N-Bio	N	P	K
46	0	55	5.40	214
	Bio	71	6.90	265
	Mean	63	6.12	240
69	0	61	5.80	225
	Bio	75	7.30	270
	Mean	68	6.55	248
92	0	69	6.40	247
	Bio	79	7.8	279
	Mean	74	7.10	263
Mean	0	62	5.90	229
	Bio	75	7.33	271
LSD at 0.05 level	Mineral	4	0.71	7
	Bio	11	0.74	14
	M X Bio	5.64	1.00	9.87

The available potassium content in soil was also affected with the investigated treatments data showed that the highest value was 279 mg/kg soil for soil treated with 92 Kg N and bio-fertilizer. Corresponding relative increases reached 30 and 48 % over 46 kg mineral N no bio-treatment and the initial K values respectively. Generally, application of urea and or bio-fertilization enhanced corn roots to absorb K from the unavailable forms and leave some residual K in available form in their zone after late maturity stage, (Mengel & Kerkby , 1979), gave near similar explanation for increasing K availability in soils with N and without K applications.

Thus, the significant favorable effect of the combination between nitrogen fertilizer doses and bio-fertilizer may be assisted on the basis of nutrient availability, vital enzymes and hormonal stimulating effect on plant growth or increasing the photosynthetic activity (Marting *et al.*, 1988).

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Macro nutrient concentrations in maize grains and stover

Data presented in Table 5 showed the effect of mineral nitrogen fertilizer and microbial inoculation on N, P and K % in maize grains and stover. The results indicate that the inoculation under mineral nitrogen fertilizer doses gave much increases in N, P and K contents in grains and stover.

TABLE 5. Effect of bacterial inoculation and mineral nitrogen on NPK % in maize grain and stover.

Treatments		N (%)		P (%)		K (%)	
mineral N-kg/fed	N-Bio	Grain	Stover	Grain	Stover	Grain	Stover
46	0	1.12	2.85	0.31	0.22	1.10	2.10
	Bio	1.26	3.50	0.38	0.27	1.21	2.71
	Mean	1.19	3.18	0.35	0.25	1.15	2.41
69	0	1.19	2.94	0.33	0.24	1.15	2.56
	Bio	1.28	3.62	0.39	0.28	1.23	2.76
	Mean	1.24	3.28	0.36	0.26	1.19	2.66
92	0	1.23	3.12	0.35	0.25	1.18	2.61
	Bio	1.30	3.96	0.41	0.32	1.25	2.85
	Mean	1.27	3.54	0.38	0.29	1.22	2.73
Mean	0	1.18	2.97	0.33	0.24	1.14	2.42
	Bio	1.28	3.69	0.39	0.29	1.23	2.77
LSD 5%	Mineral	0.42	0.43	0.13	0.04	0.28	0.77
	Bio	0.35	0.75	0.19	0.10	0.66	0.77
	M X Bio	0.59	0.61	0.18	0.06	0.40	1.10

The elevation of N % in grains and stover resulted from inoculation may be due to increase N uptake by the large root system and / or biological nitrogen fixation, either directly by the inoculants strain or indirectly by stimulating B.N.F (biological nitrogen fixation) activity of the associated rhizosphere community (Ladha *et al.*, 1998). The corresponding relative increases due to bio-combination were 22.8, 23.1 and 26.9 % in stover and 12.5, 8.0 and 6.0 in grains for treatments received 46, 69 and 92 kg N/fed , respectively compared to uninoculated treatments in the same respect .

Phosphorus content in grains and stover were corresponding relative increases P of 22.7, 16.7 and 28.0 % for stover and 22.6, 18.2 and 17.1 in grains treatments respectively, as compared to un inoculated treatments.

The corresponding relative increases of K were 29.0, 7.8 and 9.2 % in stover and 10, 7.0 and 5.9 in grains for the descending N doses, respectively, as compared to uninoculated treatments.

Nevertheless, mineral nitrogen application rates resulted in some increases by increasing them but they were less than significance limits with exception of P % in stover of plants received 92 kg N /fed which was significantly higher than those received 46 kg N/fed. It could be explained due to plant weakness under salinity conditions which did not achieve more utilization of the higher N rates . This finding emphasized the importance of the applied bio-fertilization. These results were in accordance with Shaban & Helmy (2006).

Yield of maize

The complicated factors in the work were of negative effects (as salinity) and positive one (as mineral and bio N-fertilization) which produced certain yields and yield components of maize as a function of all these effecting factors. Table 6 revealed those parameters as overall grains and stover yields (per feddan) and those belong to one plant.

Overall maize yields

Grains and stover yields followed the same trend where application of 92 kg N/ fed raised their yields significantly over the both lower rates in grains and over the lowest rate only in stover. Generally, grain yield was sensitive to elevating N rates than stover . Bio N fertilization gave significantly higher grains and stover yield than those un inculcated . The highest yields resulted from 92 kg N and bio treatment in about 120 and 56 % increases compared to 46 kg N only for grains and stover, respectively. These data are in harmony with those of El-Borollosy *et al.* (2000) and Mohammed (2004).

Moreover, specific grain weight or 100 grain weight tented to be of the same grain yield trend either due to mineral N rates or bio N –fertilization . The highest and lowest 100 grains weights produced from the same treatments mentioned in case of grain yield with percentage of increase reached 36 % . These results agreed El-Moursy & Badawi (1998); Griesh *et al.* (2001) and Rashed (2006) .

TABLE 6. Effect of bacterial inoculation and mineral nitrogen on yield and yield component of maize plant.

Treatments		Grain yield (ton/fed)	Stover yield (ton/fed)	100 Grains (gm)	Corn cob (gm/plant)	Grain (gm /plant)	Stover (gm/plant)	Yield* efficiency (%)
mineral N-kg/fed	N-Bio							
46	0	1.5	1.6	33	270	240	265	48
	Bio	2.7	2.1	42	290	278	295	56
	Mean	2.1	1.9	38	280	259	280	52
69	0	1.8	1.7	36	275	248	279	50
	Bio	2.8	2.3	43	314	284	315	54
	Mean	2.3	2.0	40	295	266	297	52
92	0	2.4	1.9	40	282	256	286	.55
	Bio	3.3	2.5	45	322	289	319	57
	Mean	2.9	2.2	43	302	273	303	56
Mean	0	1.9	1.7	36	276	248	277	51
	Bio	2.9	2.3	43	309	284	310	56
LSD at 0.05 level	Mineral	0.3	0.3	1.8	----	------	------	------
	Bio	0.5	0.5	6.3	-------	-------	------	------
	M X Bio	0.4	0.4	2.5	-------	--------	-------	-------

* Yield efficiency = grain /straw +grain x 100

Plant part weights

To overtake the behavior of plant due to the studied treatments, weights of grains , cobs and stover as well as grain to whole plant ratio or that called harvest index were detected per plant . The data confirmed those obtained per feddan to expound that plant was the unit of these changes and provided that plant numbers in all plots was approximately the same.

Conclusion

From mentioned results , we can concluded that the PGPR group had an positive effects on some soil properties such as pH and EC .N2- fixers in combination with 150 kg urea /fed gave the highest maize yield as compared to uninoculated treatment under that saline conditions.

References

Abo- Soliman, M.S.M.; Saied, M.M.; Shams, H. A.; El-Din and Abo–El-Soud, M.A. (2001) Effect of marginal water on soil physical and chemical properties. *Zagazig J.Agric.Res.*28 (6).

Aziz , M.A.; Sallam, M.F.A.; Elgendy, A.M. and Abd El-Moniem , M. (1998) Effect of natural soil conditioners and irrigation condition on some chemical properties of sandy soils of Inshas and cucumber yield. *Egypt. J. Soil Sci.* 39 (4), 531.

Bacilio, M .; Vazquez, P. and Bashan, Y. (2003) Alleviation of noxious effects of cattle ranch composts on wheat seed germination by inoculation with *Azospirillum spp. Biology and fertility of Soils.* 38 (4), 261.

Black, C. A. (1965) "*Methods of Soil Analysis*", Soil Science Society of American Inc . Publisher, Madison, Wisconsin, U.S.A.

Burr, T. J. ; Schroth, M.N. and Suslow, T. (1978) Increased potato yields by treatment of seed pieces with specific strains of *Pseudomon fluorescens* and *Pseudomonas putida*". *Phytopathology* 68 , 1377.

Chapman, H.D. and Partt, P. F. (1961) "*Methods of Analysis for Soils, Plants and Water*", Agric. Publ., University of California, Riverside.

Dobbelaere, S.; Croonenbroghs, A.; Thys, A.; Ptack, D.; Vanderleyden, J.; Labondera, G. and Kaplunik, Y. (2001) Responses of agronomical important crops to inoculation with *Azospirillum. J. Plant- Physiology* 28 (9), 671 .

El-Borollosy, M.; Zaki, S. H.; Mohammed, F. M. and Madkur, M. (2000) Influence of bio-fertilization with diazotrophs on maize yield and N2- fixation activity in rhizosphere and phyllosphere of the growing plants. *J.Environ. Sci.* 1, 609.

El-Fayoumy, M.E. and Ramadan, H. M. (2002) Effect of bio-organic Manures on sandy soils amelioration and peanut productivity under sprinkler irrigation system. *Egypt. J. Soil Sci.* 42, (3), 383.

El-Moursy, S.A. and Badawi, M.A. (1998) Nitrogen fertilizer levels and weeding regimes effect on maize and its associated weeds . *J. Agric. Sci. Mansoura Univ.* **23,** 997.

El-Rewiny, H.M. (1994) Studies on use of ozospirilla for improving growth and yield of some non-leguminous plants. *Ph. D. Thesis,* Dept . of Soils and Water, Fac. Agric., Assiut Univ., Egypt. 29, 6 , 1479.

Ghoulam, C.; Foursy, A. and Fares, A. (2002) Effects of salt stress on growth, inorganic ions and praline accumulation in relation to osmotic adjustment in five sugar beet cultivars. *Environ, Exp. Bot.* 47, 39.

Griesh, M. H.; Yakout, G. M.; Horst, W. J.; Schenk, M. K. and Burkert, A. (2001) Effect of plant population density and nitrogen fertilization on yield and yield components of some white and yellow maize hybrids under drip irrigation system in sandy soil. *Fourteenth – International Plant Nutrition- Colloquium, -Hannover-Germany.* 810.

Jackson, M.L. (1967) "*Soil Chemical Analysis*", Constable and Co. L.T.P. , London, England.

Ladha , J.K.; Kirk, G.J.D.; Bennett, J.; Reddy, C.R.; Reddy, P.M. and Singh,J. (1998) Opportunity for increased nitrogen are efficiency from improved low land rice germ plasma. *Field Crop Res.* **56**, 36.

Mantripukhri, Imphal, Manipur (2006) *Farmer's Information*. Regional Bio-fertilizers Development Centre, Department of Agriculture and Co-op. Govt. of India

Marschner, H. (1997) *"Mineral Nutrition of Higher Plants"*, 2^{nd} ed., Academic Pressinc , San Digo.

Marting, M.V.; Toledo, R.; Dela, T.; Moreno, J. and Conzalez-Lopez (1988) Root exudates of *Zea mays* and production of auxin, gibberellins and cytokinins by *Azototobacter Chroococcum* . *Plant and Soil.* **110,** 149.

Mengel, K. and Kirkby, E.A. (1979) *"Principlas of Plant Nutrition"*, 2^{nd} ed., International Potash Institute, Bern, Switzer land .

Mohammed, F. M. (2004) Influence of some N2-fixers and VA-Mycorrhizae on maize plants grown on calcareous soil under organic and inorganic fertilization. *Minufiya . J. Agric. Res.*

Mohamed, S. A.; Atta, S. Kh. and Hassan, M. A. (1998) Effect of nitrogen fertilization organic matter application and surface daring period of flooded rice on rice growth and some physiochemical changes in soil. *Egypt .J. Soil. Sci.* 38(1-4), 467.

Noel, T.C.; Yost, CK.; Pharis, R.P. and Hynes, M.F. (1996) Rhizobium *leguminosarum* as a plant growth – promoting rhizobacterium : direct groth promotion of canola and lettuce .*Canda. J. Microbiol*. 42, 279.

Nofal , F. and Hinar, A. (2003) Growth and chemical properties of maize grow of some single crosses as affected by nitrogen and manure fertilization under sprinkler irrigation in a sandy soil. *Egypt. J. Appl. Sci.* 18 (5 B) , 583.

Omar, E.A.; Refaat, A.M.; Ahmed, S.S.; Kamal, A. and Hammouda, F.M. (1993) Effect of spacing and fertilization on the yield and active constituents of mik Thistle, *Silybum marianum L. Herbs, Spices Medicinal Plants* (1), 4.

Omar, M.N.A.; Mostafa, A.T. and Ahmed, A.S. (2000) Concentration vinasse as a novel diazotrophs growth medium (Biovinasse inoculate) and soil conditioner to improve faba bean yield under dripping irrigation systems. *Proceedings of the tenth Conference of Microbiology, Egypt*, No. 12 – 14, pp. 100-110.

Omar, M.N.A. and Ismail, A. (2002) Complementation of diazotrophs and yeast as plant growth promoting a gents for wheat plants. *Egypt. J . Agric. Res.* **80** (1), 29.

Piper, C.S. (1950) *"Soil and Plant Analysis"*, Inter. Sci . Publishers. Inc., New York.

Rashed, S. H. (2006) Effect of bio and organic fertilization on *Zea mays, M.Sc. Thesis,* Fac. of Agric., Mansoura Univ., Egypt.

Schollhorn, R. and Burris, R.H. (1967) acetylene as a competitive inhibitor of nitrogen fixation . *Proc. Nat. Acad. Sci.* **58,** 213,USA.

Shaban, KH. A. (2005) Effect of different irrigation water resources on properties and productivity of salt affected soils. *Ph.D. Thesis, Fac. of Agric.*, Monufiya University, Egypt.

Shaban, KH. A. and Helmy, A.M. (2006) Response of wheat to mineral and Bio-fertilization under saline conditions. *Zagazeg J. Agric .Res.* 33 (6), 1189.

Shujins, J.J. (1973) Dehydrogenises are an indicator of biological activities in arid soils. *Bull. Ecol. Res. Commun* . (Stockholm) 17, 235.

Sndecor, G.W. and Cochran , W. G. ; (1982) "*Statistical Methods*", 7 th, Iowa, state Univ., U.S.A

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تحسين إنتاجية محصول الذرة الشامية وبعض صفات التربة باستخدام التسميد الازوتى المعدني ومجموعة حيوية لتنشيط النمو في الأراضى الملحية حديثة الاستصلاح

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تهدف هذه الدراسة إلى خدمة الاراضى الحديثة في مناطق سهل الطينة التي تصل مساحتها حوالي ٤٠,٠٠٠ فدان والتي تروى بمياه ترعة السلام المخلوطة (مياه نيل + مياه صرف زراعي) في محاولة لاستبيان إمكانية زراعة الذرة الشامية فى تلك الأراضي ذات الملوحة المتوسطة ٦,٦ مليموز /سم وتقليل الآثار الضارة من التسميد النتروجينى المعدني بإضافة التسميد الحيوي لتقليل التلوث الكميائى من ناحية والتكلفة الناتجة من استخدام التسميد المعدني من ناحية أخرى.

تم اخذ عينة من منطقة جذور نبات قمح المحصول السابق لمحصول الذرة موضوع الدراسة من نفس منطقة الدراسة وعمل عزل وتنشيط الميكروبات المثبتة للازوت الجوى منها. تم تلقيح حبوب الذرة هجين ثلاثى٣١٠ بالبكتريا لمنشطة للنمو المثبتة للازوت الجوى ازوسبيريللى برازيلنييز المعزولة من العينة سابقة الذكر وزراعتها على خطوط في نصف عدد القطع ولم يلقح النصف الأخر باعتبارها المعاملات الرئيسية وتم إضافة احد مستويات الآزوت المعدني١٠٠- ١٥٠ و ٢٠٠ كجم يوريا /فدان على ثلاث دفعات كمعاملات تحت رئيسية وإضافة التسميد الحيوي السائل أيضا على ثلاث دفعات (مع الزراعة بعد ٢١ يوما - ثم كل شهر) لتلك الملقحة بكتيريا.

وكانت النتائج كالتالي:
وجد أن هناك تحسين في بعض صفات التربة مثل درجة الملوحة ورقم الحموضة (pH) حيث انخفضت قيم الملوحة من ٦,٦ إلى ٢,٦٩ مليموز /سم وانخفض رقم الحموضة من ٨,٤٥ إلى ٧,٩٨ وذلك تحت ظروف التلقيح .

وجدت زيادة معنوية في الميسر من العناصر الكبرى النيتروجين والفسفور والبوتاسيوم في التربة تحت ظروف التلقيح البكتيري.

واظهرت النتائج زيادة معنوية في امتصاص العناصر الغذائية النيتروجين والفوسفور والبوتاسيوم نتيجة هذا التلقيح البكتيري حيث تراوحت نسبة الزيادة النسبية للعناصر في حبوب الذرة ١٢,٥ - ٢٢,٦ و ١٠ ٪ على الترتيب .

كما ظهرت زيادة معنوية في محصول الذرة الشامية وتراوحت الزيادة بين ١,٥ إلى ٢,٤ طن /فدان لتلك التي أضيف لها السماد النتروجينى المعدني فقط و ٢,٧ إلى ٣,٣ طن /فدان للحبوب المعاملة بالبكتريا والسماد النتروجينى المعدني معا.

كذالك لوحظت زيادة معنوية في وزن المائة حبة في المعاملات الملقحة عن تلك الغير ملقحة. ومازال المجال مفتوحا لمزيد من الدراسة لاستخدام هذه الكائنات الحية الدقيقة ومن جهتنا نوصى بمعاملة الذرة الشامية بالسلالة المذكورة مع إضافة ١٥٠ كجم يوريا /فدان .