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GROWTH, YIELD AND NUTRIENTS UPTAKE OF MAIZE AS AFFECTED BY ORGANICAND BIO-FERTILIZERS UNDER SALINE CONDITIONS .

El-Hadidiy,E.M[1]; E. E. E. Khafagy[2] and A.H. Serag[3]
1-Soil Dept.,Fac.,of Agric., Mansoura Univ., Egypt
2-Soil, Water and Environ. Res. Inst., ARC, Giza, Egypt.

ABSTRACT

Two field trials were conducted at El-Serw Agricultural Reserch Station, Dammietta Governorate, Egypt, in 2012 and 2013 seasons to study the effect of organic and biofertilizer on growth, yield and nutrients uptake of maize under saline conditions. A split split plot design with three replicates was conducted in this study, the main plots were assigned to different soil salinity levels treatments (low, moderate and high salinity soil), while sub-plot was devoted to the organic fertilization treatments and sub-sub plot was Bio-fertilization treatments. Three different type of organic fertilization were used in this experiment in two seasons as follows: Poultry manure, compost and farmyard manure were used at rate of (0-10-20 tons fed^{-1}).Two different type of bio-fertilization were used in this experiment inoculation with biofertilizer, *Azotobacter* Inoculation and phosphorin inoculation. The results showed the following:

Plant height, dry weight, 100-grain weight, grain yield, stover yield, N-uptake, P-uptake, K-uptake in both grains and stover of maize plant were decreased drastically with increasing salinity levels in seasons 2012&-2013 as a result of salinity stress. On the contrary, plant height, dry weight, 100-grain weight, grain yield, stover yield, N-uptake, P-uptake, K-uptake in both grains and stover of maize plant significantly increased with organic fertilization application at harvesting stage in 2012 & 2013 seasons. The order of different types and rates of organic fertilization application for their influences on previous parameters were as follows: 20 ton fed^{-1} poultry manure > 20 ton fed^{-1} compost >20 ton fed^{-1} farmyard manure >10 ton fed^{-1} poultry manure > 10 ton fed^{-1} compost >10 ton fed^{-1} farmyard manure. Maize plant height, dry weight, 100-grain weight, grain yield, stover yield, N-uptake, P-uptake, K-uptake in both grains and stover of maize plant were increased at harvesting stage in seasons 2012&2013, due to N-P biofertilization. *Azotobacter* treatment gave superior than that of phosphorin inoculations.

Effect of interaction between different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations was a significant on maize plant height and dry weight at harvesting stage in 2012&2013 seasons. A significant effect at 5% were obtained on 100 grain weight in 2012&2013 seasons by this interaction. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation). Also, the effect of this interaction was not significant on maize grain yield but a significant at 5% in strover yield in 2012 season. During 2013 season a significant at 5% was obtained in both grain and strover yield. The highest results were obtained with (low soil salinity levels +20 ton fed^{-1} poultry manure + *Azotobacter* inoculation).There was a non significant effect in N-uptake in maize grains and stover during 2012-2013 seasons. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation) . A significantly at 5% in (P-uptake & K-uptake) in maize grains and stover was obtained, respectively in both seasons. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation).

Keywords: Maize, Salinity, Poultry manure, Compost, Farmyard manure, Azotobacter, Phosphorus solubilizing bacteria.

INTRODUCTION

Maize (*Zea mays, L.*) ranks the third in the world production of cereals following wheat and rice. It is a staple food for humans and used as feed for livestock and a principal raw material for many industrial products. All parts of the crop can be used for food and non-food products. In industrialized countries, maize is largely used as livestock feed and as a raw material for industrial products.

Soil salinity has three potential effects on plants: lowering of the water potential, direct toxicity of Na^+ and Cl^- absorbed and interference with the uptake of essential nutrients. Soil salinity is characterized by high amounts of Na^+, Mg^{2+}, Ca^{2+},Cl^-, HCO_3^-, SO_4^{--} ions and boron (B), the high salt content decreases the osmotic potential of soil water and consequently, this reduces the availability of soil water for plants. Briefly, osmotic stress is caused due to the excess of Na^+ and Cl^- in the environment that decrease the osmotic potential of the soil solution and hence water uptake by plant root. Salinity also results in a reduction of K^+ and Ca^{2+} contents and an increased level of Na^+ and Cl^-, which forms its ionic effects. (Mittler, 2002; Mohammad and Mazahreh, 2003; Flowers and Flowers, 2005; Isla and Aragues, 2010 and Rasool *et al.,* 2013).

Yield are reduced in salt affected soil because of the excess uptake of potentially toxic ions. Among the abiotic stresses, drought is the most severe limitation to maize production. Maize is moderately sensitive to salinity. Yield decrease under increasing soil salinity is 0% at EC 1.7 dSm^{-1} , 10% at 2.5, 25% at 3.8, 50% at 5.9 and 100% at EC 10 dSm^{-1} . Maize gave maximum yields at EC of 2dS m^{-1} , 50 percent at EC 9 dS m^{-1} and nil at 15.3 dS m^{-1}. (Maas and Hoffman 1977; Grattan 1999 ; Sallah *et al.,* 2002 and Anjum *et al.*, 2011).

Aşık *et al.* (2009) found that high salt concentrations in the soil reduce the plants' absorption of nutrients. Thus, salinity negatively affects the fertility of the soil.

Aziz *et al.* (2010) observed that likewise organic manure substantially improved the plant height, leaf area and shoot, root fresh and dry weights. This improved growth was mainly due to increase soil nutrient availability and uptake by plants.

Mahadi (2014) found that in all the seasons and the mean plots that received 6t ha-1 poultry manure or NPK fertilizer resulted in the highest grain yield. Nyiraneza et al. (2009)found that application of cattle manure caused an increase in corn yield. Tejada and Gonzalez (2006) showed that grain protein, and maize yield indicate that the compost plus inorganic fertilizer is adequate and has a good potential for use.

Aziz et al. (2010) found that that organic matter content, phosphorus and potassium bioavailability in soil and their uptake by plants were increased by organic manure application irrespective of the source. Similarly shoot phosphorus and potassium contents were also improved by the application of organic manures. Lithourgidis *et al.*(2007) showed that, N-P-K plant concentration, and uptake were significantly increased by manure relative to the control.

Bio-fertilizers have prodigious potential to improve the plants nutrition by replacing synthetic fertilizers for ecofriendly agriculture. Bio-fertilizers contain plant growth promoting rhizobacteria (PGPR) viz; Azotobacter, Azospirillum and phosphorus solubilizing bacteria (PSB) viz; Pseudomonas sp. and Bacillus sp. having the ability of atmospheric nitrogen fixing and solubilizing the soil phosphorus, respectively. Consequently, they fulfill the nitrogen and phosphorus requirement of cereals and also improve the soil fertility. So the utilization of nitrogen fixing and phosphorus solubilizing bacteria as bio-fertilization has gigantic potential for using the atmospheric nitrogen and making use of fixed phosphorus present in the soil in crop production without causing any harmful effects on aerial and soil environment. (Yasin *et al.,* 2012).

Gholami et al. (2012) reported that Plant-growth promoting rhizobacteria (PGPR) play an important role in plant health and soil fertility. The results indicated that growth promotion by PGPR appears, from early stages of growth, 45 days after inoculation (DAI). Inoculation with PGPR increased dry weights of leaf, stem, and grain and hence total biomass sampled at 90, 105, and 120 (harvest time).

This investigation was carried out to study the effect of organic and biofertilizer on growth ,yield and nutrients uptake of maize under saline conditions.

MATERIALS AND METHDOS

Experimental Site:

Two field experiments were carried out at El Serw Agricultural Research Stations at Damietta Governorate during two seasons of 2012 & 2013.

Soil Analysis:

Soil samples were taken from the experimental site, before conducting the experiment from depths: 0-30 and 30-60cm, air dried, grounded, sieved through a 2 mm sieve and analyzed to study the soil physical and chemical properties.

At the end of each experiment soil physical and chemical properties were carried out according to Piper (1950) and Jackson (1967). As shown in Tables 1and 2. EC, cations and anions were estimated in 1:5 soil water extract, where PH was measured in soil water suspensions (1:2.5).

Growth parameters

At harvesting stage plant height and dry weight of maize plant were measured.

Yield and yield components

100-grains weight, grain yield (Mg fed^{-1}) and maize stover yield were determined at harvesting stage.

Nutritional analysis:

Oven-dried samples of maize (grain & stover) were ground in a mill using a 50-mesh screen. These samples were digested in H_2SO_4 concentrated and H_2o_2 30% according to Yash (1998).

N,P and K uptake:

N, P & K uptake as kg fed^{-1} in corn grain and stover were estimated:

$$Nutrient\ uptake\ (kg\ per\ fed) = \frac{Nutrient\ content\% \times Yield\ (kg\ per\ fed)}{100}$$

Table.1- Particle size distribution of soil samples before maize cultivation in 2012-2013 seasons.

Season	Location	Depth, cm	Particle size distribution				
			Coarse sand %	Fine sand %	Silt %	Clay %	Texture
2012	Site 1	**0-30**	1.523	11.33	21.17	65.98	Clay
		30-60	2.04	14.90	24.96	58.10	Clay
	Site 2	0-30	1.66	9.83	22.14	66.37	Clay
		30-60	2.10	14.84	24.93	58.13	Clay
	Site 3	0-30	1.74	10.82	21.03	66.41	Clay
		30-60	2.03	14.55	24.64	58.78	Clay
2013	Site 1	0-30	1.55	11.83	20.62	66.00	Clay
		30-60	2.00	14.75	24.82	58.43	Clay
	Site 2	0-30	1.78	9.56	22.07	66.59	Clay
		30-60	2.10	14.66	24.77	58.47	Clay
	Site3	0-30	1.53	11.32	21.17	65.98	Clay
		30-60	2.04	14.90	24.96	58.10	Clay

--Site 1: Low salinity. -Site 2: Medium salinity. -Site 3: High salinity.

Table. 2- Chemical properties of the studied soil samples before maize cultivation in the 2012-2013 seasons.

Season	Location	Depth, cm	EC dSm^{-1} at 25 °C	pH of soil suspend (1:2.5)	OM %	ESP %	Available		
							N Mg kg^{-1}	P Mg kg^{-1}	K Mg kg^{-1}
2012	Site 1	**0-30**	2.31	8.1	1.09	7.78	36	9.12	487
		30-60	2.43	8.0	0.92	8.65	30	7.10	440
	Site 2	**0-30**	5.10	8.2	0.97	9.54	33	8.13	463
		30-60	5.30	8.1	0.67	10.13	27	6.73	420
	Site 3	**0-30**	7.21	8.3	0.90	11.62	29	7.76	451
		30-60	7.42	8.2	0.75	13.63	24	7.10	414
2013	Site 1	**0-30**	2.00	8.0	1.10	6.83	40	10.03	496
		30-60	2.10	8.1	0.91	8.20	34	7.14	450
	Site 2	**0-30**	4.60	8.1	0.98	8.80	36	9.75	472
		30-60	4.75	7.9	0.79	9.89	32	6.89	440
	Site 3	**0-30**	7.10	8.2	0.92	10.08	33	8.60	460
		30-60	7.33	8.1	0.71	11.20	28	7.20	421

--Site 1: Low salinity. -Site 2: Medium salinity. -Site 3: High salinity.

Salinity levels treatments:

Soil samples EC was determined for the surface layer in 1:5 soil water extract and measured by dSm^{-1} at 25 °C as follows:

1-The first soil salinity level 2.31 and 2.00 dSm^{-1} for the first and second seasons, respectively.

2- The second soil salinity level 5.10 and 4.60 dSm^{-1} for the first and second seasons, respectively.

3- The third soil salinity levels were 7.21 and 7.10 dSm^{-1} for the first and second seasons, respectively.

Organic fertilization treatments:

Three different types of organic fertilization were used in this experiment in two seasons as follows:

1-Poultry manure was used at rate of (0-10-20 ton fed^{-1}).

2-Compost was used by at rate of (0-10-20 ton fed^{-1}).

3- Farmyard manure was used at rate of (0-10-20 ton fed^{-1}).

Organic fertilization were added to the soil and mixed with the upper layer before maize cultivation in the two seasons. The analysis of varied types of organic fertilization was illustrated in the following Table 3 .

Table. 3- The analysis of organic fertilizer .

Property	Organic fertilizer		
	Farmyard Manure	**Compost**	**Poultry manure**
Total N%	0.73	1.30	1.94
Total P%	0.53	0.61	0.74
Total K%	1.79	1.90	2.37
O.M%	30.08	43.3	61.00
EC(1:10)dSm^{-1}	6.72	5.52	4.20
pH(1:10)	8.1	7.53	7.51

Bio-fertilization treatments:

Three different treatments of bio-fertilization were used in this experiment in the two seasons as follows:

1- without inoculation (control treatment).

2- Inoculation with biofertilizer, *Azotobacter* (free living N_2-fixing bacteria).

3-Inoculation with biofertilizer, Phosphorin (this product contain efficient strain of bacteria solubilizing phosphorus).

Experimental Design:

A split split plot design with three replicates was conducted in this study, the main plots were assigned to soil salinity levels treatments while sub-plot was devoted to the organic fertilization treatments and sub-sub plot was Bio-fertilization treatments.

Cultivation and harvesting operation:

Maize (*Zea mays L.*) variety single cross 30K8, was grown in the two seasons 2012 & 2013 dates of maize planting and harvesting for the growing seasons are present in Table(4).

Table. 4- Dates of maize planting and harvesting processes in the tow growing seasons.

Operation	**Seas on 2012**	**Season 2013**
Maize sowing	17 of May 2012	12 of May 2012
Maize harvesting	7 of October 2013	3 of October 2013

Field preparation, seeding operation and all other agricultural practices for soil management, recommended fertilizers, pesticides, etc. were performed according to the usual local agricultural management. Irrigation was applied by pumping water from the nearest source of water.

Statistical Analysis:

Data collected were subjected to the statistical analysis according to Snedecor and Cochran (1967). Mean values were compared at the 5% and 1%levels of significance by using the Least Significance Difference(LSD) test.

RESULTS AND DISCUSSION

Plant height & Dry weight

According to the data contained in the Table 5, maize plant height & dry weight was significantly affected by different soil salinity levels at harvesting stage, whereas maize maize plant height & dry weight were depressed with increased salinity levels during 2012&2013 seasons. Acually high soil salinity has three potential effects on plants: lowering of the potential water, direct toxicity of Na^+ and Cl^- and the uptake of essential nutrients. These results are consistent with finding by Irshad *et al* (2002); Munns (2002); Zeng *et al*. (2002) ; Munns (2005) and Kang *et al.*(2010). On the contrary, maize maize plant height & dry weight were significantly increased with organic fertilization application at harvesting stage in 2012 & 2013 seasons. A positive result was noticed in maize plant height & dry weight by the use of humic substances. Indeed, humic substances have direct and indirect effects on plant growth. The direct effects are those that require the uptake of humic substances into the plant tissue resulting in various biochemical outcomes, but the indirect effects involve the improvement of soil properties Tan (2003) and Sangeetha *et al.*(2006). The order of different types and rates of organic fertilization application for their influences on maize maize plant height & dry weight were as follows: 20 ton fed^{-1} poultry manure > 20 ton fed^{-1} compost >20 ton fed^{-1} farmyard manure >10 ton fed^{-1} poultry manure > 10 ton fed^{-1} compost >10 ton fed^{-1} farmyard manure. The varied effects of different types and rates of organic fertilizers are attributed to the difference of its nutrients contents, its ability to improving soil properties and its rate of application for each type. In general, these results are in line with Materechera and Salagae (2002); Aziz et al. (2010); Okonmah (2012) and Enujeke (2013). In 2012 & 2013 seasons, N-P biofertilizer inoculations were influencing factors in the significant increase which was noticed in maize plant height & dry weight after both sowing growth period and harvesting stage. Data in Table 5 also expounds that the order of N-P biofertilizer inoculations for their influences on maize maize plant height & dry weight were as follows: *Azotobacter* inoculation then phosphorin (phosphorus solubilizing bacteria). Increasing in maize plant height & dry weight could be attributed to nitrogen role in cell elongation. These results are in accordance with those obtained by Sachin and Misra (2009); Gholami *et al.* (2012) and Yasin *et al.*(2012). Data in Table 5 explicates the interaction between organic fertilizers and N-P biofertilizer inoculations effect. In 2012 season, the effect of that interaction was significant on maize plant at harvesting stage. In season 2013, one more significant increase on maize plant height & dry weight recorded 5% at harvesting stage. The highest values of maize plant height & dry weight were obtained when 20 ton fed^{-1} poultry manure with *Azotobacter* inoculation treatment was used followed by 20 $tonfed^{-1}$ Compost with *Azotobacter* inoculation then 20 ton fed^{-1} poultry manure with phosphorin inoculation. The lowest results were obtained by non organic fertilizer with non inoculation treatments. The supply of organic matter can promote the dispersal and the activity of applied plant growth-promoting rhizobacteria, interactive effects of applied bacterial strains and organic fertilization depend on the sort of organic fertilizer and crop species used (Krey *et al*.,2011). Data in Table 5 clarifys the consequence of different soil salinity levels and N-P biofertilizer inoculations treatments interaction. Maize maize plant height & dry weight were significantly increased at harvesting stage in 2012 season. In the same season another significant effect was obtained at harvesting stage. Using of low soil salinity levels with *Azotobacter* inoculation treatment gave the highest result at harvesting stage. The results of using phosphorin inoculation with low soil salinity levels were lower than previous results. The lowest results were obtained by using high salinity soil levels with non inoculation treatments in both seasons. The use of nitrogen fixing plant growth promoting bacteria may represent an important biotechnological approach to decrease the impact of salinity in corn, as it alleviated the saline stress in maize likely through the integration of several mechanisms that improve the plant response (Rojas-Tapias *et al.,* 2012). Data in Table 5 shows the effect of different soil salinity levels and organic fertilizer treatments interaction. Consequently, maize plant height was a significantly increased at harvesting stage in 2012 & 2013 seasons. The highest results were obtained by lowing salinity soil level treatment with 20 ton fed^{-1} poultry manure then lowing salinity soil level treatment with 20 ton fed^{-1} compost followed by low salinity soil level with 20 ton fed^{-1} farmyard Manure treatment. Organic manure provide anti-stress effects to plants under a biotic stress conditions by reducing the uptake of some toxic elements, good water relation, improving cations and anions exchange and solubility and increasing free proline content under saline conditions which was reflected on producing better growth parameters. (Kulikova *et al.,* 2005; Abou El-Magd *et al.,*2008 and Hakan *et al.*, 2010). Data in Table 5 expounds the outcome of different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations interaction. Maize plant height & dry weight were significantly affected by the outcome of these interactions harvesting stage in 2012&2013 seasons. The highest results were obtained with (low soil salinity level + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation).

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100-grains weight:

Data in Table 6 indicates that there was a significant decrease in maize100-grain weight by the cause of different soil salinity levels in both seasons 2012-2013. Similar results were obtained by Ashrafuzaman *et al.*(2000). In addition, data in Table 6 showed that there was a significant increase in maize 100-grain weight caused by the favor of organic fertilization in both 2012 &2013 seasons. Data in Table also shows that the order of organic fertilization for their influences on maize highest 100-grain weight was as follows: 20 ton fed^{-1} poultry manure > 20 ton fed^{-1} compost > 20 ton fed^{-1} farmyard manure. Similar results were obtained by Dordas *et al.* (2008); Farhad *et al.* (2009) and Okonmah (2012). This increase is due to effect of nitrogen from any source on grains filling which reflected on their weights. Moreover, data in Table 6 indicated that N-P biofertilizers inoculations affected on maize 100-grain weight significantly in both 2010 and 2013 seasons. The highest results were obtained *Azotobacter* inoculation followed by phosphorin inoculation. These results are similar with those obtained by Zahir *et al.*(2005) . Data in Table 6 shows the influence of organic fertilizers and N-P biofertilizer inoculations interaction. In 2012 and 2013 seasons, the interaction affected significantly at 5% on maize 100-grain weight. The highest values of 100-graine weight were obtained when 20 ton fed^{-1} poultry manure with *Azotobacter* inoculation treatment was used followed by 20 ton fed^{-1} poultry manure with phosphorin inoculation then 20 ton fed^{-1} Compost with *Azotobacter* inoculation. The lowest results were obtained by non organic fertilizer with non inoculation treatments. Data in Table 6 shows the effect of different soil salinity levels and N-P biofertilizer inoculations treatments interaction. The effect of this interaction on maize 100-grain weight was a significant in (2012&2013) seasons. Using of low soil salinity levels with *Azotobacter* inoculation treatment gave the highest result. The results of using phosphorin inoculation with low soil salinity levels were lower than previous results. The lowest results were obtained by using high salinity soil levels with non inoculation treatments in 2012 & 2013 seasons. Data in Table 6 shows the effect of different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations interaction. The effect of this interaction was significant effect at 5%. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation), (low soil salinity levels + 20 ton fed^{-1} poultry manure + phosphorin). The lowest values were obtained with (low soil salinity levels + non organic fertilizer + non biofertilization) in both 2012&2013 seasons.

Grain and Stover yield:

According to the data contained in Table 6 shows that maize grain and stover yield were significantly affected by different soil salinity levels. It was noticed that grain and stover yield decreased drastically with increasing salinity levels in both seasons 2012&2013. Yield are reduced in salt affected soil because of the excess uptake of potentially toxic ions, salinity also causes numerous physiological and biochemical changes in plants which ultimately reduce the crop yield Grattan (1999) and Hussain *et al*. (2013). These results are generally in a good a agreement with finding by Maas and

Hoffman (1977);Grattan (1999) Ashrafuzzaman *et al.*(2000);Sallah *et al*. (2002) ; Amer (2010) ;Isla and Aragues (2010) and Anjum *et al*. (2011). In addition, maize grain and stover yield were significantly increased with organic fertilization application in 2012 and 2013 seasons. humic substances have appositive effect on maize grain and stover yield. Actually, humic substances affects directly and indirectly on plant growth. The direct effects are those that require the uptake of humic substances into the plant tissue resulting in various biochemical outcomes, but the indirect effects involve the improvement of soil properties which ultimately increase the crop yield (Tan 2003 and Sangeetha *et al.*, 2006). In other word, Data in Table 6 also explicates that the order of different organic fertilization application for their influences on maize grain yield was as follows: 20 ton fed^{-1} poultry manure > 20 ton fed^{-1} compost >20 ton fed^{-1} farmyard manure >10 ton fed^{-1} poultry manure > 10 ton fed^{-1} compost >10 ton fed^{-1} farmyard manure. The varied effects of different types and rates of organic fertilizers are attributed to the difference of its nutrients contents, its ability to improving soil properties and its rate of application for each type. In general, these results agree with those obtained by Lithourgidis *et al.*(2007); Dordas *et al.* (2008); Farhad *et al.* (2009); Materechera and Morutse (2009); Uzoma *et al.* (2011); Okonmah (2012); Enujeke (2013); Holbeck *et al.* (2013); Zhao *et al.* (2013) and Mahadi (2014). During 2012 and 2013 seasons, a significant increase was noticed on maize grain and stover yield due to N-P biofertilizer inoculations. Data in Table 5 also shows that the order of N-P biofertilizer inoculations for their influences on maize maize grain and stover yield was as follows: *Azotobacter* inoculation then Phosphorin (phosphorus solubilizing bacteria). Increasing in maize grain and stover yield could be attributed to phosphorus solubilizing microorganisms have a great tendency to enhance the provision of soluble phosphate and increase the growth and development of crop plants by enhancing biological nitrogen fixation. *Azotobacter* could increase maize yield by stimulating processes such as seed germination, resistance of seedlings to stress conditions, nitrogen fixation and production of phytohormones (Ponmurugan and Gopi 2006 and Timea *et al.* 2012. In general, these results agree with those obtained by Zahir *et al.*(2005); Ponmurugan and Gopi (2006); Gholami *et al.*(2012) and Timea *et al.* (2012). Data in Table 6 shows the effect of organic fertilizers and N-P biofertilizer inoculations interaction . In 2012&2013 seasons, the interaction resulted in a significant effect on maize grain and stover yield. The highest values of grain and stover yield were obtained when 20 ton fed^{-1} poultry manure with *Azotobacter* inoculation treatment was used followed by 20 $tonfed^{-1}$ Compost with *Azotobacter* inoculation then 20 ton fed^{-1} farmyard manure with *Azotobacter*. The lowest results were obtained by non organic fertilizer with non inoculation treatments. Interactive effects of applied bacterial strains and organic fertilization depend on the sort of organic fertilizer and crop species used Krey *et al*.(2011). Data in Table 6 expounds the effect of different soil salinity levels and N-P biofertilizer inoculations treatments interaction. The effect of this interaction on maize grain yield was not significant but a significant at 5% in 2012 & 2013 seasons, respectively.

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The effect of this interaction on maize strover yield was a significant at 5% in both seasons. Using of low soil salinity levels with *Azotobacter* inoculation treatment gave the highest result on grain and strover yield. The results of using Phosphorin inoculation with low soil salinity levels were lower than previous results. The lowest results were obtained by using high salinity soil levels with non inoculation treatments in both (2012 & 2013) seasons. Data in Table 6 shows the effect of different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations interaction. The effect of this interaction was not significant on maize grain yield but a significant at 5% in strover yield in 2012 season. During 2013 season a significant at 5% was obtained in both grain and strover yield. The highest results were obtained with (low soil salinity level +20 ton fed^{-1} poultry manure + Azotobacter inoculation), (low soil salinity levels + 20 ton fed^{-1} compost + *Azotobacter*) and (low soil salinity level + 20 ton fed^{-1} farmyard manure + *Azotobacter* inoculation).

Nitrogen uptake (kg-N fed^{-1}) in maize grains and stover:

Data in Table 7 showed the effect of different soil salinity levels, different type of organic fertilization application, N-P biofertilization inoculations and their interactions on nitrogen uptake by maize grains and stover. There was a significant decrease in N-uptake in maize grains and stover by increasing soil salinity levels in both seasons Table 7. Salt accumulation in soils may induce osmotic changes, interfere with nitrogen uptake and nitrogen concentration in both grains and strover. These results are similar with finding of Apse *et al.* (1999);Ashrafuzzaman *et al.*(2000); Irshad *et al* (2002) and Yuncai *et al.*(2007). Also, there was a significant increment in N-uptake in maize grains and stover by applying organic fertilization in both seasons 2012 and 2013 Table 7. The highest mean value of N-uptake in grains and stover in 2012 & 2013 seasons was recorded when 20 ton fed^{-1} poultry manure followed by 20 ton fed^{-1} compost then 20 ton fed^{-1} farmyard manure, respectively. The above results are generally in a good agreement with the findings of Dordas *et al.*(2008); Nyiraneza *et al.* (2009); Aziz *et al.* (2010); Uzoma *et al.* (2011) ;Mahadi (2014) and Palanivell *et al.*(2013). Also, there was a significant increment in N-uptake in maize grains and stover by N-P inoculations in both 2012 and 2013 seasons. The highest value of N-uptake in maize grain and stover in 2012 and 2013 seasons was recorded when *Azotobacter* inoculant was applied followed by phosphorin. This effect of N-biofertilizer inoculations on nitrogen uptake could be attributed to the high efficiency of these inoculations on fixing atmospheric nitrogen and/or to produce some biological active substances, *e.g.,* gibberellins and cytokine. The above results are generally in a good agreement with the findings of Peix *et al.* (2001) and Zahir *et al.* (2005). Results in Table 6 showed that interaction effect between organic fertilizers and N-P biofertilizer inoculations interaction. There was a significant increment in N-uptake in maize grains and stover in 2012 & 2013 seasons by this interaction. The highest values of N-uptake in maize grains and stover was obtained when 20 ton fed^{-1} poultry manure with *Azotobacter* inoculation treatment was used. Data in Table 7 shows the effect of different soil salinity levels and N-P biofertilizer inoculations treatments interaction.

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The effect of this interaction in N-uptake in maize grains and stover was a significantly at 5% level in 2012&2013 seasons. Using of low soil salinity levels with *Azotobacter* inoculation treatment gave the highest result in N-uptake in maize grains and stover in both (2012 & 2013) seasons. Data in Table 7 explicates the interaction between different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations and its consequences.. There was a non significant effect in N-uptake in maize grains and stover during 2012-2013 seasons. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation) then (low soil salinity levels + 20 ton fed^{-1} Compost + *Azotobacter*) .

Phosphorus uptake(kg-N fed^{-1}) in maize grains and stover:

Data in Table 8 showed the effect of different soil salinity levels, different types of organic fertilization application, N-P biofertilization inoculations and their interactions on uptake by maize grains and stover. There was a significant decrease in P-uptake in maize grains and stover due to increasing soil salinity levels in both seasons 2012 & 2013 Table 8. Salt accumulation in soils may induce osmotic changes, interfere with phosphorus uptake in both grains and strover. These results are similar with finding of Apse *et al.* (1999); Irshad *et al* (2002) and Yuncai *et al.*(2007). Also, there was a significant increment in P-uptake in maize grain and stover in 2012 & 2013 seasons, by using organic fertilization. The highest mean value of P-uptake in grains and stover in 2012 and 2013 seasons was recorded when 20 ton fed^{-1} poultry manure followed by 20 ton fed^{-1} compost then 20 ton fed^{-1} farmyard manure, respectively. The above results are generally in a good agreement with the findings of Lithourgidis *et al.*(2007); Aziz *et al.* (2010); Uzoma *et al.* (2011) Palanivell *et al.*(2013) and Mahadi (2014). Also, there was a significant increment in P-uptake in maize grains and stover by N-P inoculations in both 2012 and 2013 seasons. The highest value of P-uptake in maize grain and stover in 2012 and 2013 seasons was recorded when *Azotobacter* inoculant was applied followed by Phosphorin. This effect of P-biofertilizer inoculations on increasing P-uptake in maize plant could be attributed to phosphate solubilizing microorganisms convert these insoluble phosphates into soluble forms through the process of acidification, chelation, exchange reactions and production of gluconic acid Rodriguez *et al.* (2004); Chung *et al.* (2005). These results are similar with finding of Rodriguez and Fraga (1999). Results in Table 8 showed that interaction effect between organic fertilizers and N-P biofertilizer inoculations interaction. There was a significant increment in P-uptake in maize grains and stover by this interaction in both 2012 and 2013 seasons. The highest values of P-uptake in maize grains and stover was obtained when 20 $tonfed^{-1}$ Poultry Manure with *Azotobacter* inoculation treatment was used. Data in Table 8 shows the effect of different soil salinity levels and N-P biofertilizer inoculations treatments interaction. The effect of this interaction on P-uptake in maize grains and stover was a significantly at 5% level in 2012&2013 seasons. Using of low soil salinity levels with *Azotobacter* inoculation treatment gave the highest result P-uptake in maize grains and stover in both (2012 & 2013) seasons.

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Data in Table 8 shows the effect of different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations interaction. A significantly at 5% in P-uptake in maize grains and stover was obtained, respectively in 2012&2013 seasons. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation) .

:

Data in Table 9 shows the effect of different soil salinity levels, different types of organic fertilization application, N-P biofertilization inoculations and their interactions on potassium uptake by maize grains and stover. There was a significant decrease in K-uptake in maize grains and stover due to increasing soil salinity levels in both seasons 2012 and 2013 . Excess Na^+ and Cl^- inhibits the uptake of K^+ and lead to the appearance of symptoms like those in K^+ deficiency Gopal and Dube (2003). These results are similar with finding of Ashrafuzzaman *et al.* (2000) ;Irshad *et al* (2002) ;Gopal and Dube (2003) ;Karimi *et al*. (2005); Yuncai *et al.* (2007) and Aşık *et al*. (2009). Also, there was a significant increment in K-uptake in maize grains and stover by applying organic fertilization in both seasons 2012 and 2013 Table 9. The highest value of K-uptake in maize grains and stover was obtained by 20 ton fed^{-1} poultry manure followed by 20 $tonfed^{-1}$ compost, 20 $tonfed^{-1}$ farmyard Manure, respectively in both 2012 and 2013. The above results are generally in a good agreement with the findings of Aziz *et al.* (2010) ; Uzoma *et al.* (2011) ; Palanivell *et al.* (2013) ; Das *et al.*(2013) and Mahadi (2014). Also, there was a significant increment in K-uptake in maize grains and stover by N-P inoculations in both 2012 and 2013 seasons. The highest value of K-uptake in maize grain and stover in 2012 and 2013 seasons was recorded when *Azotobacter* inoculant was applied followed by Phosphorin. Results in Table 9 showes the interaction effect between organic fertilizers and N-P biofertilizer inoculations interaction. Regarding to K-uptake in maize grains and stover there was a significant increment in K-uptake was obtained. The highest values of K-uptake in maize grains and stover was obtained by 20 $tonfed^{-1}$ Poultry Manure with *Azotobacter* inoculation treatment then 20 ton fed^{-1} compost with *Azotobacter* inoculation treatment. Data in Table 9 shows the effect of different soil salinity levels and N-P biofertilizer inoculations treatments interaction. The effect of this interaction on K-uptake in maize grains and stover was a significantly effect. Using of low soil salinity levels with *Azotobacter* gave the best results. Data in Table 9 shows the effect of different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations interaction. This interaction effect on K-uptake in maize grains and stover, was a significant at 5% in 2012&2013seasons. The highest results were obtained with (low soil salinity levels + 20 ton fed^{-1} poultry manure + *Azotobacter* inoculation).

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CONCLUSION

Generally, it could be concluded that under saline soil condition in North Delta region, applying organic and biofertilization (*Azotobacter* and Phosphorin) is very important to obtain permanent productivity of maize plant.

REFERENCES

Amer, K. H. (2010).Corn crop response under managing different irrigation and salinity levels. Agricultural Water Management, 97(10): 1553-1563.

Anjum, S.A.; L.C. Wang; M. Farooq; M. Hussain; L.L. Xue and C.M. Zou (2011). Brassinolide application improves the drought tolerance in maize through modulation of enzymatic antioxidants and leaf gas exchange. Journal Agronomy Crop Science, 197: 177-185.

Apse, M.P; G.S. Aharon, W.A. Snedden and E. Blumwald (1999). Salt tolerance conferred by overexpression of a vacuolar Na+/H+ antiport in Arabidopsis. Science, 285: 1256–1258.

Ashrafuzzaman, M. ; M. A. H. Khan, S. M. Shohidullah and M .S. Rahman (2000).Effect of salinity on the chlorophyll content, yield and yield component of QPM CV. Nutricta. Pakistan Journal of Biological Science, 3(1):43-46.

Aziz, T.; S. Ullah ; A. Sattar; M. Nasim ; M. Farooq and M. M. Khan, (2010). Nutrient availability and maize (*Zea mays, L.*) growth in soil amended with organic manures. International Journal Agricultural Biological, 12: 621–624.

Chung, H.; M. Park,; M. Madhaiyan,; S. Seshadri,; J. Song,; H. Cho, and T. Sa (2005). Isolation and characterization of phosphate solubilizing bacteria from the rhizosphere of crop plants of Korea. Soil Biol. Biochem. 37, 1970–1974.

Das, D. K.; B. R. Dey; M. J. A. Mian and M. A. Hoque (2013). Mitigation of the adverse effects of salt stress on maize (*Zea mays L*.) through organic amendments. International Journal Applied Science Biotechnology, 1(4): 233-239

Dordas, C. A. ;A. S. Lithourgidis; S. Anastasios; T. Matsi and N. Barbayiannis (2008). Application of liquid cattle manure and inorganic fertilizers affect dry matter, nitrogen accumulation, and partitioning in maize. Nutrient cycling in agroecosystems,80(3): 283-296.

Enujeke, E.C. (2013). Effects of poultry manure on growth and yield of improved maize in asaba area of delta state, Nigeria. Journal of Agriculture and Veterinary Science,4(1): 24-30.

Farhad,W.; M. F. Saleem; M. A. Cheema and H. M. Hammad, (2009). Effect of poultry manure levels on the productivity of spring maize (*Zea mays, L.*). The Journal of Animal and Plant Sciences 19(3):122-125.

Flowers, T.J. and S.A. Flowers (2005). Why does salinity pose such a difficult problem for plant breeders. Agriculture Water Management, 78: 15-24.

Gholami, A.;A. Biyari .M. Gholipoor and H. Asadi Rahmani (2012). growth promotion of maize (*Zea mays, L.*) by plant-growth-promoting rhizobacteria under field conditions .Communications in Soil Science and Plant Analysis, 43(9):1263-1272.

Gopal, R. and B. K. Dube (2003). Influence of variable potassium on barley metabolism. Annals of Agricultural Research, 24: 73-77.

Grattan, S. R. and C. M. Grieve (1999). Salinity mineral nutrient relations in horticultural crops. Scientia Horticulturae, 78, 127-157

Holbeck, B. ;W Amelung;A. Wolf; K. Südekum; M. Schloter and W. Gerhard (2013). Recoveries of 15N-labelled fertilizers (chicken manure, mushroom compost and potassium nitrate) in arable topsoil after autumn application to winter cover crops . Soil and Tillage Research, 130 : 120-127.

Hussain, M.; H.W. Park; M. Farooq; K. Jabran and D. J. Lee (2013). Morphological and physiological basis of salt resistance in different rice genotypes. International Journal Of Agriculture and Biology,15,113-118.

Irshada, M. ; S. Yamamotoa ;A. E. Enejia; T. Endoa and T. Honnaa (2002). Urea and manure effect on growth and mineral contents of maize under saline conditions. Journal of Plant Nutrition,25(1): 189-200.

Isla, R. and R. Aragues (2010).Yield and plant ion concentrations in maize (*Zea mays, L.*)subject to diurnal and nocturnal saline sprinkler irrigations . Field Crops Research, 116(1-2):175-183.

Jackson, M.L. (1967). "Soil Chemical Analysis". Prentice-Hall of India, New Delhi.

Karimi, G.; M. Ghorbanli; H. Heidari ; R. A. Khavarinejad and M. H. Assareh (2005).The effects of NaCl on growth, water relations, osmolytes and ion contentin Kochia prostrate. Biol. Plant, 49: 301–304.

Krey, Th ; M. Caus ; CH. Baum ; S. Ruppel and B. Eichler-Lobermann (2011). Interactive effects of plant growth-promoting rhizobacteria and organic fertilization on P nutrition of *Zea mays, L.* and *Brassica napus, L* . Journal of Plant Nutrition and Soil Science,174(4): 602-613.

Lithourgidis, A. S; T. Matsi; N. Barbayiannis and C. A. Dordas (2007). Effect of liquid cattle manure on corn yield, composition and soil properties. Agronomy Journal,99(4): 1041-1047.

Maas, E.V. and G.J. Hoffman (1977). Crop salt tolerance - current assessment. J. Irrig. Drainage Div. ASCE., 103: 115-134.

Mahadi, M. A.(2014). Growth, nutrient uptake and yield of maize (*Zea mays, L.*) as influenced by weed control and poultry manure . International Journal of Advanced Biological Research,5(1):94.

Materechera, S.A. and A.M. Salagae (2002). Use of partially-decomposed cattle and chicken manure amended with wood-ash in two South African arable soils with contrasting texture: effect on nutrient uptake, early growth, and dry matter yield of maize. Communications in Soil Science and Plant Analysis, 33 (1/2): 179-201.

Materechera, S.A. and H.M. Morutse (2009). Response of maize to phosphorus from fertilizer and chicken manure in a semi-arid environment of South Africa. Experimental Agriculture,45(3): 261-273.

Mittler, R. (2002). Oxidative stress, antioxidants and stress tolerance. Trends in Plant Science,7: 405-410.

Mohammad, M. J. and N. Mazahreh (2003). Changes in soil fertility parameters in response to irrigation of forage crops with secondary treated wastewater. Communications in Soil Science and Plant Analysis, 34:(9-10).

Munns, R. (2005). Genes and salt tolerance: bringing them together. New Phytologist,167:645-663.

Nyiraneza, J.; M. H. Chantigny ; A. Dayegamiye and M. R. Laverdiere (2009). Dairy cattle manure improves soil productivity in low residue rotation systems. Agronomy Journal, 101, 207-214.

Okonmah, L. U.(2012). Effects of various organic manure on the growth and yield of maize in asaba agro – ecological zone. Asian Journal of Science and Technology.4(11): 6-9.

Palanivell1,P.;K. Susilawati1; O. H. Ahmed And A.M. N. Muhamad (2013). Effects of crude humin and compost produced from selected waste on *Zea mays* growth, nutrient uptake and nutrient use efficiency. African Journal of Biotechnology, 12(13):1500-1507.

Peix A.; A. A. Rivas-Boyero; P.F. Mateos; C. Rodriguez-Barrueco; E. Martinez-Molina and E. Velasquez (2001). Growth promotion of chickpea and barley by a phosphate solubilizing strain of *Mesorhizobium* nitrogen utilization by wheat plants. Plant Soil, 245: 215-222.

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

Ponmurugan, P. and C. Gopi (2006). Distribution pattern and screening of phosphate solubilizing bacteria isolated from different food and forage. Journal of Agronomy and Crop Science,5: 600-604.

Rasool, S.; A. Hameed; M.M. Azooz; M. Rehman; T.O. Siddiqi and P. Ahmad, (2013). Salt stress: causes, types and response of plants. In: Ecophysiology and response of plants under salt stress, Springer LLC, New York. pp. 1-24.

Rodriguez, H. F. Reynaldo(1999). Phosphate solubilizing bacteria and their role in plantgrowth promotion. Biotechnology Advances, 17, 319-339.

Rodriguez, H.; . Gonzalez, ; I. Goire, , and Y. Bashan (2004). Gluconic acid production and phosphate solubilization by the plant growth-promoting bacterium Azospirillum spp. Naturewissenschaften 91, 552–555.

Sachin, D., N and P. Misra (2009). Effect of *Azotobacter chroococcum* (PGPR) on the Growth of Bamboo (*Bambusa bamboo*) and Maize (*Zea mays*) Plants Biofrontiers,1(1): 24-31.

Sallah, P.Y.K.; K.O. Antwi and M.B. Ewool, (2002). Potential of elite maize composites for drought tolerance in stress and non-drought stress environments. Afr. J. Crop Sci., 10: 19

Sangeetha, M; P. Singaram and R.D. Devi, (2006). Effect of lignite humic acid and fertilizers on the yield of onion and nutrient availability. Proceedings of 18th World Congress of Soil Science July 9-15, Philadelphia, Pennsylvania, USA.

Snedecor, G.W. and W.G. Cochran (1967). "Statistical Methods", 6^{th} Edition, Lowa State College. Press, Ams. Lowa, USA.

Tan, K.H. (2003). Humic Matter in Soil and Environment, Principles and Controversies. Marcel Dekker, Inc., Madison, New York.

Timea H. J.; L. Dragana and. D. Simonida; Nastasija M and O. N. Mrkovacki (2012). The use of *Azotobacter* in organic maize production. Research Journal of Agricultural Science, 44 (2).12

Uzoma, K.C.; M. Inoue; H. Andry; H. Fujimaki; A. Zahoor; and E. Nishihara (2011).Effect of cow manure biochar on maize productivity under sandy soil condition. Soil Use and Management, 27 (2): 205-212.

Yash P. K.(1998)."Handbook Reference Methods for plant Analysis". CRC Press Boca Raton Boston London New York Washington, D.C.

Yasin, M.; A. Kaleem ;M. Waqas and T. Asif , (2012). Bio-fertilizers, substitution of synthetic fertilizers in cereals for leveraging agriculture. Crop and Environment, 3 (1-2): 62-66.

Yuncai, H.;B. Zoltan;V.T. Sabine and S. Urs (2007). Short-term effects of drought and salinity on mineral nutrient distribution along growing leaves of maize seedlings. Environmental and Experimental Botany, 60(1): 268-275.

Zahir, Z.A.; H.N. Asghar; M. J. Akhtar and M. Arshad (2005).Precursor (*L-tryptophan*)-inoculum (*Azotobacter*) interaction for improving yields and nitrogen uptake of maize. Journal of Plant Nutrition, 28(5): 805-817

Zeng, L., M. C. Shannon and C. M. Grieve, (2002). Evaluation of salt tolerance in rice genotypes by multiple agronomic parameters. Euphytica, 127: 235-245.

Zhao, B.; J. Chen; J. Zhang; X. Xin and X. Hao (2013). How different long term fertilization strategies influence crop yield and soil properties in a maize field in the North China Plain. Journal of Plant Nutrition and Soil Science, 179(1): 99-109.

نمو ومحصول وامتصاص العناصر الغذائية في الذرة متأثرة بالتسميد العضوي والحيوي تحت الظروف الملحية.

السيد محمود الحديدي[1] و الحسيني المرسى السيد خفاجى[2] وأيمن حاكم سراج[2]
1- قسم علوم الأراضي-كلية الزراعة-جامعة المنصورة
2- معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر.

أجريت تجربتان حقليتان في محطة البحوث الزراعية بالسرو بمحافظة دمياط خلال الموسمين الصيفيين لعامي2012 2012-2013 لدراسة تأثير التسميد العضوي والحيوي على نمو ومحصول وامتصاص العناصر الغذائية تحت الظروف الملحية. استخدم تصميم القطع المنشقة مرتين مع ثلاث مكررات في هذه التجربة حيث استخدم ثلاث مستويات مختلفة في الملوحة كقطع رئيسية وهى (منخفضة الملوحة ومتوسطة الملوحة وعالية الملوحة) والتسميد العضوى كقطع تحت رئيسية وكان التسميد الحيوى كقطع تحت تحت رئيسية. واستخدم ثلاث أنواع من التسميد العضوي سماد الدواجن والكبوست والسماد البلدي بمعدلات مختلفة (0-10-20) طن فدان$^{-1}$ خلال الموسمين. بالنسبة للتسميد العضوي استخدم لقاح الأزوتوباكتر ولقاح الفوسفورين.
وكانت النتائج المتحصل عليها كالتالي:
أدت زيادة الملوحة إلى حدوث نقص معنوى فى كل من طول النبات, والوزن الجاف, ووزن 100 حبة, ومحصول الحبوب, ومحصول الحطب, و كمية النيتروجين والفسفور والبوتاسيوم الممتصة لكل من الحبوب والحطب لنبات الذرة. وبالعكس أدت إضافة الأسمدة العضوية بأنواعها ومعدلاتها المختلفة لحدوث زيادة معنوية في كل من الصفات السابقة لنبات الذرة لكل من الموسمين 2012-2013, وكان ترتيب الأنواع المختلفة والمعدلات المختلفة للسماد العضوي على الصفات السابقة كالاتى: 20 طن فدان$^{-1}$سماد الدواجن> 20 طن فدان$^{-1}$ سماد الكمبوست > 20 طن فدان$^{-1}$سماد البلدى >10 طن فدان$^{-1}$سماد الدواجن > 10 طن فدان$^{-1}$ سماد الكمبوست > 10 طن فدان$^{-1}$ سماد البلدى ..كما نتج عن إضافة الأسمدة الحيوية أيضا حدوث زيادة معنوية لهذه الصفات وكان لقاح الأزوتوباكتر متفوقا على لقاح الفوسفورين خلال الموسمين 2012-2013 .
ويتضح من تأثير التداخل بين مستويات الملوحة المختلفة و التسميد العضوى و التسميد الحيوى على كل من طول النبات, والوزن الجاف, ووزن 100 حبة, ومحصول الحبوب, ومحصول الحطب, و كمية النيتروجين والفوسفور والبوتاسيوم الممتصة لكل من الحبوب والحطب لنبات الذرة عند مرحلة الحصاد أن أعلى النتائج التى تم الحصول عليها (مستوى المنخفض الملوحة + 20 طن فدان$^{-1}$ سماد الدواجن+ لقاح الأزوتوباكتر).

Table 5: Effect of interactions among different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations on plant height and dry weight in 2012-2013 seasons.

Treatment		2012						2013					
		Plant heigh(cm) at harvest stage			Dry weight (gm) at harvest stage			Plant heigh(cm) at harvest stage			Dry weight (gm) at harvest stage		
		S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h
O_0	I_0	219.0	199.0	135.0	371.85	258.02	216.66	241.6	217.5	146.2	410.15	282.01	234.64
	I_1	240.0	216.0	153.0	389.18	279.60	243.00	264.7	236.1	165.7	429.27	305.60	263.17
	I_2	231.0	209.0	142.0	364.55	266.50	232.32	254.8	228.4	153.8	402.10	291.28	251.60
O_1	I_0	225.6	207.0	137.7	394.16	276.08	223.16	248.8	226.2	149.1	434.75	301.75	241.68
	I_1	247.2	224.6	156.1	412.53	299.17	250.29	272.7	245.5	169.0	455.02	326.99	271.06
	I_2	237.9	217.4	144.8	386.43	285.16	239.29	262.4	237.6	156.9	426.23	311.67	259.15
O_2	I_0	232.3	215.2	140.5	417.81	295.40	229.85	256.3	235.3	152.1	460.84	322.88	248.93
	I_1	254.6	233.6	159.2	437.29	320.11	257.80	280.8	255.4	172.4	482.33	349.88	279.20
	I_2	245.1	226.1	147.7	409.61	305.12	246.47	270.3	247.1	160.0	451.80	333.49	266.93
O_3	I_0	239.3	223.8	143.3	442.87	316.08	236.75	264.0	244.7	155.2	488.49	345.48	256.40
	I_1	262.3	243.0	162.4	463.52	342.52	265.53	289.3	265.6	175.8	511.27	374.37	287.57
	I_2	252.4	235.1	150.7	434.19	326.47	253.86	278.4	257.0	163.2	478.91	356.84	274.93
O_4	I_0	246.5	232.8	146.1	469.45	338.21	243.85	271.9	254.5	158.3	517.80	369.66	264.09
	I_1	270.1	252.7	165.6	491.33	366.50	273.50	297.9	276.2	179.4	541.94	400.58	296.20
	I_2	260.0	244.5	153.7	460.24	349.33	261.48	286.8	267.2	166.5	507.65	381.81	283.18
O_5	I_0	253.9	242.1	149.1	497.61	361.88	251.17	280.0	264.6	161.4	548.87	395.54	272.02
	I_1	278.2	262.8	168.9	520.81	392.15	281.70	306.9	287.2	182.9	574.46	428.62	305.08
	I_2	267.8	254.3	156.8	487.86	373.78	269.32	295.4	277.9	169.8	538.10	408.54	291.68
O_6	I_0	261.5	251.8	152.0	527.47	387.21	258.70	288.4	275.2	164.7	581.80	423.23	280.18
	I_1	286.6	273.3	172.3	552.06	419.60	290.15	316.1	298.7	186.6	608.93	458.62	314.24
	I_2	275.8	264.5	159.9	517.13	399.94	277.40	304.2	289.0	173.2	570.39	437.14	300.43
F. Test		**			**			**			**		
LSD 5%		2.859			6.823			3.146			7.523		
LSD 1%		3.415			8.148			3.757			8.985		
F. Test	S	**			**			**			**		
	O	**			**			**			**		
	I	**			**			**			**		
	O× I	**			**			**			**		
	S×I	**			**			**			**		
	S*O	**			**			**			**		

***Significant at 5% level.**
**** Significant at 1% level.**
S_l = Low salinity.
S_m=Moderate salinity.
S_h = High salinity.
O_0= Without organic fertilizer
O_1 =10 ton fed^{-1} farmyard Manure
O_2=10 ton fed^{-1} compost
O_3 =10 tonfed^{-1} poultry manure
O_4= 20 ton fed^{-1} farmyard Manure
O_5 =20 ton fed^{-1} compost
O_6=20 ton fed^{-1} poultry manur
I_0= Without inoculation
I_1=*Azotobacter* inoculate
I_2=Phosphorin inoculate

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Table 6: Effect of interactions among different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations on 100 grain weight, grain yield and stover yield in 2012& 2013 seasons.

Treatment		2012									2013								
		100 grain weight (gm)			Grain yield (Mg fed^{-1})			stover yield(Mg fed^{-1})			100 grain weight (gm)			Grain yield (Mg fed^{-1})			stover yield(Mg fed^{-1})		
		S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h
O_0	I_0	28.11	17.34	4.95	2.849	1.590	0.735	4.060	2.280	1.040	31.01	18.95	5.36	3.137	1.769	0.743	4.471	2.535	1.051
	I_1	31.89	21.21	7.33	3.270	1.872	0.909	4.660	2.683	1.286	35.17	23.18	7.94	3.634	2.100	0.919	5.179	3.011	1.301
	I_2	29.69	19.67	5.96	3.084	1.732	0.797	4.395	2.483	1.127	32.75	21.50	6.45	3.409	1.931	0.805	4.857	2.768	1.140
O_1	I_0	32.33	19.42	5.45	2.877	1.603	0.740	4.100	2.298	1.047	35.66	21.23	5.90	3.169	1.783	0.748	4.515	2.555	1.059
	I_1	36.67	23.76	8.06	3.310	1.891	0.917	4.716	2.710	1.297	40.45	25.96	8.73	3.678	2.121	0.928	5.241	3.041	1.312
	I_2	34.14	22.03	6.56	3.118	1.747	0.803	4.443	2.505	1.136	37.66	24.08	7.10	3.446	1.948	0.812	4.911	2.793	1.149
O_2	I_0	37.18	21.75	5.99	2.906	1.616	0.745	4.141	2.316	1.055	41.00	23.77	6.49	3.200	1.797	0.753	4.561	2.576	1.066
	I_1	42.17	26.61	8.87	3.349	1.909	0.925	4.773	2.737	1.309	46.52	29.08	9.61	3.722	2.142	0.936	5.304	3.071	1.324
	I_2	39.27	24.67	7.21	3.152	1.763	0.809	4.492	2.527	1.145	43.31	26.97	7.81	3.484	1.966	0.818	4.965	2.818	1.158
O_3	I_0	42.75	24.36	6.59	2.935	1.629	0.751	4.183	2.335	1.062	47.16	26.63	7.14	3.232	1.811	0.759	4.606	2.597	1.073
	I_1	48.50	29.80	9.76	3.390	1.929	0.933	4.830	2.765	1.321	53.50	32.57	10.57	3.766	2.164	0.944	5.367	3.102	1.336
	I_2	45.15	27.63	7.93	3.187	1.779	0.816	4.542	2.550	1.154	49.81	30.20	8.59	3.522	1.984	0.825	5.019	2.843	1.167
O_4	I_0	49.16	27.28	7.25	2.965	1.642	0.756	4.225	2.354	1.069	54.23	29.82	7.85	3.265	1.826	0.764	4.652	2.617	1.081
	I_1	55.78	33.37	10.73	3.430	1.948	0.942	4.888	2.792	1.333	61.52	36.48	11.62	3.812	2.185	0.953	5.432	3.133	1.348
	I_2	51.93	30.95	8.73	3.222	1.795	0.822	4.592	2.573	1.164	57.28	33.83	9.45	3.561	2.001	0.831	5.075	2.869	1.177
O_5	I_0	56.54	30.56	7.97	2.994	1.655	0.761	4.267	2.373	1.077	62.36	33.40	8.63	3.297	1.840	0.769	4.699	2.638	1.089
	I_1	64.14	37.38	11.81	3.471	1.967	0.950	4.947	2.820	1.345	70.75	40.86	12.78	3.857	2.207	0.961	5.497	3.164	1.360
	I_2	59.72	34.67	9.60	3.258	1.811	0.829	4.642	2.596	1.173	65.87	37.89	10.40	3.600	2.019	0.838	5.130	2.895	1.186
O_6	I_0	65.02	34.23	8.77	3.024	1.668	0.766	4.310	2.391	1.084	71.72	37.41	9.50	3.330	1.855	0.775	4.746	2.659	1.096
	I_1	73.76	41.86	12.99	3.513	1.987	0.959	5.006	2.848	1.357	81.36	45.76	14.06	3.904	2.229	0.970	5.563	3.196	1.373
	I_2	68.67	38.83	10.56	3.293	1.827	0.836	4.693	2.620	1.182	75.75	42.44	11.43	3.640	2.038	0.845	5.187	2.921	1.195
F. Test		*			ns			*			*			*			*		
LSD 5%		1.584			--------			0.041			1.743			0.057			0.041		
LSD 1%		2.093			--------			0.054			2.304			0.076			0.054		
F. Test	S	**			**			**			**			**			**		
	O	**			**			**			**			**			**		
	I	**			**			**			**			**			**		
	O× I	*			**			**			*			**			**		
	S×I	**			ns			*			**			*			*		
	S*O	**			*			*			**			*			**		

***Significant at 5% level.**
**** Significant at 1% level.**
S_l = Low salinity.
S_m=Moderate salinity.
S_h = High salinity.
O_0= Without organic fertilizer
O_1 =10 ton fed^{-1} farmyard Manure
O_2=10 ton fed^{-1} compost
O_3 =10 tonfed^{-1} poultry manure
O_4= 20 ton fed^{-1} farmyard Manure
O_5 =20 ton fed^{-1} compost
O_6=20 ton fed^{-1} poultry manur
I_0= Without inoculation
I_1=*Azotobacter* inoculate
I_2=Phosphorin inoculate

Table 7: Effect of interactions among different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations on N-Uptake grain and N-Uptake stover in 2012-2013 seasons.

Treatment		2012						2013					
		N-Uptake grain (kg fed.$^{-1}$)			N-Uptake stover (kg fed.$^{-1}$)			N-Uptake grain (kg fed.$^{-1}$)			N-Uptake stover (kg fed.$^{-1}$)		
		S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h
O_0	I_0	49.54	25.93	11.45	2.12	1.12	0.49	55.22	29.16	11.70	2.36	1.25	0.50
	I_1	59.96	31.12	14.63	2.56	1.34	0.62	67.57	35.31	14.96	2.89	1.52	0.64
	I_2	54.99	28.35	12.72	2.35	1.22	0.54	61.52	31.96	13.00	2.63	1.37	0.55
O_1	I_0	50.53	26.38	11.65	2.16	1.13	0.49	56.33	29.66	11.90	2.41	1.28	0.51
	I_1	61.28	31.71	14.91	2.62	1.36	0.63	69.07	35.98	15.25	2.95	1.55	0.65
	I_2	56.15	28.86	12.95	2.40	1.24	0.55	62.82	32.54	13.23	2.69	1.40	0.56
O_2	I_0	51.55	26.83	11.85	2.20	1.15	0.50	57.46	30.16	12.10	2.46	1.30	0.51
	I_1	62.64	32.32	15.19	2.68	1.39	0.64	70.59	36.67	15.54	3.02	1.58	0.66
	I_2	57.33	29.39	13.19	2.45	1.26	0.56	64.14	33.13	13.47	2.74	1.42	0.57
O_3	I_0	52.59	27.29	12.05	2.25	1.17	0.51	58.62	30.68	12.31	2.51	1.32	0.52
	I_1	64.02	32.94	15.48	2.74	1.42	0.66	72.16	37.37	15.84	3.08	1.61	0.67
	I_2	58.54	29.92	13.43	2.50	1.29	0.57	65.50	33.73	13.71	2.80	1.45	0.58
O_4	I_0	53.64	27.75	12.26	2.29	1.19	0.52	59.79	31.20	12.52	2.56	1.34	0.53
	I_1	65.44	33.57	15.78	2.80	1.44	0.67	73.75	38.08	16.14	3.15	1.64	0.69
	I_2	59.78	30.46	13.67	2.56	1.31	0.58	66.88	34.34	13.96	2.86	1.48	0.59
O_5	I_0	54.72	28.23	12.47	2.34	1.21	0.53	61.00	31.74	12.73	2.61	1.36	0.54
	I_1	66.89	34.21	16.08	2.86	1.47	0.68	75.38	38.81	16.45	3.22	1.67	0.70
	I_2	61.04	31.01	13.92	2.61	1.33	0.59	68.29	34.96	14.21	2.92	1.50	0.60
O_6	I_0	55.82	28.71	12.68	2.39	1.23	0.54	62.22	32.28	12.95	2.66	1.39	0.55
	I_1	68.37	34.86	16.39	2.92	1.50	0.70	77.05	39.55	16.76	3.29	1.70	0.71
	I_2	62.33	31.57	14.17	2.66	1.36	0.60	69.73	35.59	14.47	2.98	1.53	0.61
F. Test		ns			ns			ns			ns		
LSD 5%		--------			--------			--------			--------		
LSD 1%		--------			--------			--------			--------		
F. Test	S	**			**			**			**		
	O	**			**			**			**		
	I	**			**			**			**		
	O× I	**			**			**			**		
	S×I	*			*			**			**		
	S*O	ns			ns			*			*		

***Significant at5% level.**
**** Significant at 1% level.**
S_l = Low salinity.
S_m=Moderate salinity.
S_h = High salinity.
O_0= Without organic fertilizer
O_1 =10 ton fed^{-1} farmyard Manure
O_2=10 ton fed^{-1} compost
O_3=10 tonfed^{-1}poultry manure
O_4= 20 ton fed^{-1} farmyard Manure
O_5 =20 ton fed^{-1} compost
O_6=20 ton fed^{-1} poultry manur
I_0=Without inoculation
I_1=*Azotobacter* inoculate
I_2=Phosphorin inoculate

Table 8: Effect of interactions among different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations on P-Uptake grain and P-Uptake stover in 2012-2013 seasons.

Treatment		2012						2013					
		P-uptake grain(kg fed.$^{-1}$)			P-uptake stover(kg fed.$^{-1}$)			P-uptake grain(kg fed.$^{-1}$)			P-uptake stover(kg fed.$^{-1}$)		
		S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h
O_0	I_0	9.30	4.59	1.71	0.77	0.32	0.09	10.46	5.21	1.76	0.86	0.36	0.10
	I_1	11.26	5.59	2.15	0.93	0.38	0.12	12.78	6.40	2.22	1.06	0.44	0.12
	I_2	10.93	5.35	1.96	0.90	0.37	0.11	12.34	6.09	2.02	1.02	0.42	0.11
O_1	I_0	9.49	4.67	1.73	0.81	0.33	0.10	10.67	5.30	1.79	0.91	0.38	0.10
	I_1	11.51	5.70	2.19	0.98	0.41	0.13	13.06	6.53	2.26	1.12	0.47	0.13
	I_2	11.16	5.44	1.99	0.95	0.39	0.11	12.60	6.20	2.06	1.08	0.44	0.12
O_2	I_0	9.68	4.75	1.76	0.86	0.35	0.11	10.89	5.39	1.82	0.96	0.40	0.11
	I_1	11.76	5.80	2.23	1.04	0.43	0.13	13.35	6.65	2.30	1.18	0.50	0.14
	I_2	11.40	5.54	2.03	1.01	0.41	0.12	12.87	6.31	2.09	1.14	0.47	0.13
O_3	I_0	9.88	4.83	1.79	0.90	0.37	0.11	11.11	5.48	1.85	1.02	0.43	0.12
	I_1	12.02	5.91	2.27	1.10	0.46	0.14	13.65	6.78	2.35	1.25	0.53	0.15
	I_2	11.64	5.64	2.06	1.07	0.44	0.13	13.14	6.42	2.13	1.20	0.50	0.13
O_4	I_0	10.07	4.91	1.83	0.95	0.40	0.12	11.33	5.58	1.88	1.07	0.45	0.12
	I_1	12.29	6.03	2.32	1.16	0.49	0.15	13.95	6.91	2.39	1.32	0.56	0.16
	I_2	11.89	5.74	2.10	1.13	0.46	0.14	13.42	6.54	2.17	1.27	0.53	0.14
O_5	I_0	10.28	4.99	1.86	1.01	0.42	0.13	11.56	5.67	1.92	1.13	0.48	0.13
	I_1	12.56	6.14	2.36	1.23	0.52	0.16	14.26	7.04	2.44	1.40	0.59	0.17
	I_2	12.14	5.85	2.14	1.19	0.49	0.15	13.70	6.66	2.21	1.34	0.56	0.15
O_6	I_0	10.48	5.08	1.89	1.06	0.44	0.14	11.79	5.77	1.95	1.20	0.50	0.14
	I_1	12.84	6.26	2.40	1.30	0.55	0.17	14.57	7.17	2.48	1.48	0.63	0.18
	I_2	12.39	5.95	2.18	1.26	0.52	0.16	13.99	6.78	2.25	1.42	0.59	0.16
F. Test		**ns**			*****			*			*		
LSD 5%		------			0.019			0.189			0.021		
LSD 1%		------			0.025			0.250			0.028		
F. Test	S	**			**			**			**		
	O	**			**			**			**		
	I	**			**			**			**		
	O× I	**			**			**			**		
	S×I	*			*			*			*		
	S*O	*			*			*			*		

***Significant at 5% level.**
**** Significant at 1% level.**
S_l = Low salinity.
S_m=Moderate salinity.

S_h = High salinity.
O_0= Without organic fertilizer
O_1 =10 ton fed^{-1} farmyard Manure
O_2=10 ton fed^{-1} compost

O_3 =10 tonfed^{-1} poultry manure
O_4= 20 ton fed^{-1} farmyard Manure
O_5 =20 ton fed^{-1} compost
O_6=20 ton fed^{-1} poultry manur

I_0= Without inoculation
I_1=*Azotobacter* inoculate
I_2=Phosphorin inoculate

Table 9:Effect of interactions among different soil salinity levels, organic fertilizer treatments and N-P biofertilizer inoculations on K-Uptake grain and K-Uptake stover in 2012-2013 seasons.

Treatment		2012						2013					
		K-uptake grain(kg fed.$^{-1}$)			K-uptake stover(kg fed.$^{-1}$)			K-uptake grain(kg fed.$^{-1}$)			K-uptake stover(kg fed.$^{-1}$)		
		S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h	S_l	S_m	S_h
O_0	I_0	9.75	5.54	2.35	5.96	3.33	1.36	10.97	6.29	2.43	6.71	3.78	1.40
	I_1	11.42	6.59	2.98	6.98	3.96	1.73	12.96	7.55	3.08	7.92	4.53	1.78
	I_2	10.80	6.11	2.62	6.60	3.67	1.52	12.18	6.96	2.71	7.45	4.18	1.57
O_1	I_0	9.95	5.63	2.39	6.29	3.52	1.44	11.19	6.40	2.47	7.08	4.00	1.49
	I_1	11.67	6.71	3.04	7.38	4.20	1.84	13.25	7.69	3.14	8.38	4.81	1.90
	I_2	11.02	6.22	2.67	6.97	3.89	1.61	12.44	7.09	2.76	7.87	4.43	1.67
O_2	I_0	10.15	5.73	2.43	6.64	3.73	1.53	11.41	6.51	2.51	7.47	4.23	1.58
	I_1	11.93	6.84	3.10	7.81	4.45	1.96	13.54	7.84	3.20	8.86	5.10	2.02
	I_2	11.26	6.34	2.72	7.37	4.12	1.72	12.70	7.21	2.80	8.31	4.69	1.77
O_3	I_0	10.35	5.83	2.47	7.01	3.94	1.63	11.64	6.62	2.55	7.88	4.48	1.68
	I_1	12.20	6.97	3.16	8.26	4.72	2.08	13.84	7.99	3.26	9.37	5.41	2.15
	I_2	11.49	6.45	2.77	7.78	4.37	1.82	12.97	7.34	2.86	8.78	4.97	1.88
O_4	I_0	10.56	5.93	2.51	7.40	4.17	1.73	11.88	6.73	2.59	8.32	4.74	1.79
	I_1	12.47	7.10	3.22	8.73	5.00	2.22	14.15	8.14	3.32	9.91	5.73	2.29
	I_2	11.74	6.57	2.82	8.22	4.63	1.94	13.25	7.48	2.91	9.28	5.27	2.00
O_5	I_0	10.77	6.03	2.56	7.81	4.42	1.84	12.12	6.84	2.64	8.78	5.02	1.90
	I_1	12.74	7.24	3.28	9.24	5.31	2.36	14.46	8.30	3.39	10.48	6.08	2.44
	I_2	11.98	6.69	2.87	8.69	4.90	2.06	13.53	7.61	2.96	9.80	5.58	2.13
O_6	I_0	10.99	6.13	2.60	8.24	4.68	1.95	12.36	6.96	2.68	9.27	5.31	2.02
	I_1	13.02	7.38	3.34	9.77	5.63	2.51	14.78	8.45	3.45	11.08	6.45	2.60
	I_2	12.24	6.81	2.92	9.18	5.19	2.19	13.81	7.75	3.01	10.36	5.91	2.27
F. Test			*			*			*			*	
LSD 5%			0.160			0.137			0.183			0.155	
LSD 1%			0.211			0.180			0.242			0.205	
F. Test	S		**			**			**			**	
	O		**			**			**			**	
	I		**			**			**			**	
	O× I		**			**			**			**	
	S×I		**			**			**			**	
	S*O		*			*			*			*	

***Significant at 5% level.**
**** Significant at 1% level.**
S_l = Low salinity.
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I_0= Without inoculation
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