

Growth, yield and nutrients uptake of maize as affected by organic and bio-fertilizers under saline conditions .

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ABSTRACT

Two field trials were conducted at El-Serw Agricultural Research Station, Damietta 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 stover yield in 2012 season. During 2013 season a significant at 5% was obtained in both grain and stover 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^{2-} 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 $\text{EC } 1.7 \text{ dSm}^{-1}$, 10% at 2.5, 25% at 3.8, 50% at 5.9 and 100% at $\text{EC } 10 \text{ dSm}^{-1}$. Maize gave maximum yields at $\text{EC of } 2 \text{ dS m}^{-1}$, 50 percent at $\text{EC } 9 \text{ dS m}^{-1}$ 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 1 and 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 H₂SO₄ concentrated and H₂O₂ 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:

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

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

Season	Location	Depth, cm	Particle size distribution				Texture
			Coarse sand %	Fine sand %	Silt %	Clay %	
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	1.00	11.83	20.72	67.00	Clay
		30-60	2.00	14.70	24.82	58.48	Clay
	Site 2	0-30	1.78	9.06	22.07	67.09	Clay
		30-60	2.10	14.76	24.77	58.47	Clay
	Site 3	0-30	1.03	11.32	21.17	66.98	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	8.60	30	7.10	440
	Site 2	0-30	5.10	8.2	0.97	9.04	33	8.13	473
		30-60	5.30	8.1	0.77	10.13	27	7.73	420
	Site 3	0-30	7.21	8.3	0.90	11.72	29	7.76	451
		30-60	7.42	8.2	0.70	13.73	24	7.10	414
2013	Site 1	0-30	2.00	8.0	1.10	7.83	40	10.03	496
		30-60	2.10	8.1	0.91	8.20	34	7.14	400
	Site 2	0-30	4.60	8.1	0.98	8.80	36	9.70	472
		30-60	4.75	7.9	0.79	9.89	32	7.89	440
	Site 3	0-30	7.10	8.2	0.92	10.08	33	8.70	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%	0.03	0.61	0.74
Total K%	1.79	1.90	2.37
O.M%	30.08	43.3	71.00
EC(1:10) dSm^{-1}	7.72	0.02	4.20
pH(1:10)	8.1	7.03	7.01

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 plant height & dry weight were depressed with increased salinity levels during 2012 & 2013 seasons. Actually 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 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 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 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 ton fed⁻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 clarifies the consequence of different soil salinity levels and N-P biofertilizer inoculations treatments interaction. 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).

100-grains weight:

Data in Table 6 indicates that there was a significant decrease in maize 100-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.

The effect of this interaction on maize stover 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 stover 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 stover yield in 2012 season. During 2013 season a significant at 5% was obtained in both grain and stover 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 stover. 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.

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 stover. 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.

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 shows 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).

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.

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

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أجريت تجربتان حقلية في محطة البحوث الزراعية بالسرو بمحافظة دمياط خلال الموسمين الصيفيين لعامي ٢٠١٢-٢٠١٣ 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 وهي (منخفضة الملوحة ومتوسطة الملوحة وعالية الملوحة) والتسميد العضوي كقطع تحت رئيسية وكان التسميد الحيوي كقطع تحت رئيسية. واستخدم ثلاث أنواع من التسميد العضوي سماد الدواجن والكمبوست والسماد البلدي بمعدلات مختلفة (٢٠-١٠-٠) طن فدان^{-١} خلال الموسمين. بالنسبة للتسميد العضوي استخدم لقاح الأروتوباكتر ولقاح الفوسفورين. وكانت النتائج المتحصل عليها كالتالي:

أدت زيادة الملوحة إلى حدوث نقص معنوي في كل من طول النبات، والوزن الجاف، ووزن حبة، ومحصول الحبوب، ومحصول الحطب، وكمية النيتروجين والفوسفور 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 ٢٠١٢-٢٠١٣، وكان ترتيب الأنواع المختلفة والمعدلات المختلفة للسماد العضوي على الصفات السابقة كالآتي: ٢٠ طن فدان^{-١} سماد الدواجن < ٢٠ طن فدان^{-١} سماد الكمبوست < ٢٠ طن فدان^{-١} سماد البلدي < ١٠ طن فدان^{-١} سماد الدواجن < ١٠ طن فدان^{-١} سماد الكمبوست < ١٠ طن فدان^{-١} سماد البلدي. كما نتج عن إضافة الأسمدة الحيوية أيضا حدوث زيادة معنوية لهذه الصفات وكان لقاح الأروتوباكتر متفوقا على لقاح الفوسفورين خلال الموسمين ٢٠١٢-٢٠١٣.

ويتضح من تأثير التداخل بين مستويات الملوحة المختلفة والتسميد العضوي والتسميد الحيوي على كل من طول النبات، والوزن الجاف، ووزن حبة، ومحصول الحبوب، ومحصول الحطب، وكمية النيتروجين والفوسفور والبوتاسيوم الممتصة لكل من الحبوب والحطب لنبات الذرة عند مرحلة الحصاد أن أعلى النتائج التي تم الحصول عليها (مستوى المنخفض الملوحة + ٢٠ طن فدان^{-١} سماد الدواجن + لقاح الأروتوباكتر).

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 height (cm) at harvest stage			Dry weight (gm) at harvest stage			Plant height (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	219.1	199.1	170.1	271.80	208.12	211.77	241.7	217.0	147.2	41.10	282.1	222.72
	I ₁	241.1	217.1	103.1	289.18	279.20	242.11	272.7	237.1	170.7	429.27	302.10	272.17
	I ₂	231.1	209.1	142.1	272.00	277.00	232.22	202.8	228.8	103.8	402.10	291.28	201.70
O ₁	I ₀	220.7	207.1	127.7	292.17	277.08	222.17	248.8	227.2	149.1	422.70	301.70	241.78
	I ₁	227.2	222.7	107.1	412.02	299.17	200.29	277.7	240.0	179.0	400.22	277.99	271.77
	I ₂	227.9	217.2	142.8	287.22	280.17	229.29	272.2	227.7	107.9	427.22	311.77	209.10
O ₂	I ₀	222.2	210.2	120.0	417.81	290.20	229.80	207.2	220.2	102.1	417.80	272.88	248.92
	I ₁	202.7	222.7	109.2	427.29	220.11	207.80	280.8	200.2	172.2	482.22	249.88	279.20
	I ₂	220.1	227.1	147.7	409.71	300.12	247.27	270.2	247.1	170.0	401.80	222.29	277.92
O ₃	I ₀	229.2	222.8	142.2	422.87	317.08	227.70	272.0	242.7	100.2	488.29	240.28	207.20
	I ₁	212.2	222.8	122.2	422.02	242.02	270.02	289.2	270.7	170.8	011.27	272.27	287.07
	I ₂	202.2	220.1	100.7	422.19	227.27	202.87	278.2	207.0	172.2	478.91	207.82	272.92
O ₄	I ₀	227.0	222.8	147.1	429.20	228.21	242.80	271.9	202.0	108.2	017.80	279.77	272.09
	I ₁	270.1	202.7	170.7	491.22	277.00	272.00	297.9	277.2	179.2	021.92	400.08	297.20
	I ₂	271.0	222.0	102.7	422.22	242.22	271.28	287.8	277.2	177.0	007.70	281.81	282.18
O ₅	I ₀	202.9	222.1	129.1	497.71	271.88	201.17	280.0	272.7	171.2	048.87	290.02	272.02
	I ₁	278.2	222.8	128.9	020.81	292.10	281.70	307.9	287.2	182.9	072.27	428.72	300.08
	I ₂	277.8	202.2	107.8	487.87	272.78	272.22	290.2	277.9	179.8	028.10	428.02	291.78
O ₆	I ₀	271.0	201.8	102.0	027.27	287.21	208.70	288.2	270.2	172.7	081.80	422.22	280.18
	I ₁	287.7	272.2	172.2	002.07	419.70	290.10	317.1	298.7	187.7	708.92	408.72	312.22
	I ₂	270.8	272.0	109.9	017.12	299.92	277.20	302.2	289.0	172.2	070.29	427.12	300.22
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 x I	**			**			**			**		
	S x I	**			**			**			**		
	S x O	**			**			**			**		

*Significant at 5% level.

** Significant at 1% level.

S_l = Low salinity.

S_m = Moderate salinity.

S_h = High salinity.

O₀ = Without organic fertilizer

O₁ = 10 ton fed⁻¹ farmyard Manure

O₂ = 10 ton fed⁻¹ compost

O₃ = 10 ton fed⁻¹ poultry manure

O₄ = 20 ton fed⁻¹ farmyard Manure

O₅ = 20 ton fed⁻¹ compost

O₆ = 20 ton fed⁻¹ poultry manur

I₀ = Without inoculation

I₁ = Azotobacter inoculate

I₂ = Phosphorin inoculate

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	4.90	2.849	1.091	0.730	4.074	2.280	1.040	31.01	18.90	0.37	3.137	1.719	0.743	4.471	2.030	1.001
	I ₁	31.89	21.21	7.33	3.270	1.872	0.909	4.770	2.783	1.281	30.17	22.18	7.94	3.734	2.100	0.919	0.179	3.011	1.301
	I ₂	29.79	19.77	0.97	3.084	1.732	0.797	4.390	2.483	1.127	32.70	21.00	7.40	3.409	1.931	0.800	4.807	2.778	1.140
O ₁	I ₀	32.33	19.42	0.40	2.877	1.703	0.740	4.100	2.298	1.047	30.77	21.22	0.90	3.179	1.783	0.748	4.010	2.000	1.009
	I ₁	37.77	23.77	8.07	3.310	1.891	0.917	4.717	2.710	1.297	28.40	20.97	8.73	3.778	2.121	0.928	0.241	3.041	1.312
	I ₂	34.14	22.02	7.07	3.118	1.747	0.803	4.443	2.000	1.137	27.77	24.08	7.10	3.447	1.948	0.812	4.911	2.792	1.149
O ₂	I ₀	37.18	21.70	0.99	2.907	1.717	0.740	4.141	2.317	1.000	41.00	23.77	7.49	3.200	1.797	0.703	4.071	2.077	1.077
	I ₁	42.17	27.71	8.87	3.349	1.909	0.900	4.773	2.737	1.309	47.02	29.08	9.71	3.772	2.142	0.937	0.304	3.071	1.324
	I ₂	39.27	24.77	7.21	3.102	1.763	0.809	4.492	2.027	1.140	43.31	27.97	7.81	3.444	1.977	0.818	4.970	2.818	1.108
O ₃	I ₀	42.70	24.37	7.09	2.930	1.729	0.701	4.183	2.330	1.072	47.17	27.73	7.14	3.222	1.811	0.709	4.707	2.027	1.073
	I ₁	48.00	29.80	9.77	3.390	1.929	0.923	4.833	2.770	1.321	03.00	22.07	10.07	3.777	2.174	0.944	0.377	3.102	1.337
	I ₂	40.10	27.73	7.93	3.187	1.779	0.817	4.042	2.000	1.104	49.81	20.00	8.09	3.022	1.984	0.820	0.19	2.843	1.177
O ₄	I ₀	49.17	27.28	7.20	2.970	1.742	0.707	4.220	2.304	1.079	44.23	29.82	7.80	3.270	1.827	0.774	4.702	2.717	1.081
	I ₁	00.78	33.37	10.73	3.430	1.948	0.944	4.888	2.792	1.323	71.02	33.48	11.72	3.812	2.180	0.903	0.432	3.132	1.348
	I ₂	01.93	30.90	8.73	3.222	1.790	0.822	4.092	2.073	1.174	07.28	33.83	9.40	3.071	2.001	0.831	0.070	2.819	1.177
O ₅	I ₀	07.04	30.07	7.97	2.994	1.700	0.711	4.277	2.372	1.077	72.37	33.40	8.73	3.297	1.840	0.779	4.799	2.738	1.089
	I ₁	74.14	37.38	11.81	3.471	1.977	0.900	4.947	2.820	1.340	70.70	40.87	12.78	3.807	2.207	0.971	0.497	3.174	1.370
	I ₂	09.72	34.77	9.70	3.208	1.811	0.829	4.742	2.077	1.172	70.87	37.89	10.40	3.700	2.019	0.838	0.130	2.890	1.187
O ₆	I ₀	70.02	34.23	8.77	3.024	1.778	0.777	4.310	2.391	1.084	71.72	37.41	9.00	3.320	1.800	0.770	4.747	2.709	1.097
	I ₁	73.77	41.87	12.99	3.013	1.987	0.909	0.007	2.848	1.307	81.37	40.77	14.07	3.904	2.229	0.970	0.073	3.197	1.373
	I ₂	78.77	38.83	10.07	3.293	1.827	0.827	4.793	2.720	1.182	70.70	42.44	11.43	3.740	2.038	0.840	0.187	2.921	1.190
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	**			**			**			**			**			**		
	OxI	*			**			**			*			**			**		
	SxI	**			ns			*			**			*			*		
	S*O	**			*			*			**			*			**		

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

S_h = High salinity.
 O₀= Without organic fertilizer
 O₁ =10 ton fed⁻¹ farmyard Manure
 O₂=10 ton fed⁻¹ compost

O₃ =10 tonfed⁻¹ poultry manure
 O₄= 20 ton fed⁻¹ farmyard Manure
 O₅ =20 ton fed⁻¹ compost
 O₆=20 ton fed⁻¹ poultry manur

I₀= Without inoculation
 I₁=Azotobacter inoculate
 I₂=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	49.04	20.93	11.40	2.12	1.12	0.49	00.22	29.17	11.70	2.37	1.20	0.00
	I ₁	09.97	31.12	14.73	2.07	1.34	0.72	77.07	30.31	14.97	2.89	1.02	0.74
	I ₂	04.99	28.30	12.72	2.30	1.22	0.04	71.02	31.97	13.00	2.73	1.37	0.00
O ₁	I ₀	00.03	22.38	11.70	2.17	1.13	0.49	07.33	29.77	11.90	2.41	1.28	0.01
	I ₁	71.28	31.71	14.91	2.72	1.37	0.73	79.07	30.98	10.20	2.90	1.00	0.70
	I ₂	07.10	28.87	12.90	2.40	1.24	0.00	72.82	32.04	13.23	2.79	1.40	0.07
O ₂	I ₀	01.00	22.83	11.80	2.20	1.10	0.00	07.47	30.17	12.10	2.47	1.30	0.01
	I ₁	72.74	32.32	10.19	2.78	1.39	0.74	70.09	37.77	10.04	3.02	1.08	0.77
	I ₂	07.33	29.39	13.19	2.40	1.27	0.07	74.14	33.13	13.47	2.74	1.42	0.07
O ₃	I ₀	02.09	27.29	12.00	2.20	1.17	0.01	08.72	30.78	12.31	2.01	1.32	0.02
	I ₁	74.02	32.94	10.48	2.74	1.42	0.77	72.17	37.37	10.84	3.08	1.71	0.77
	I ₂	08.04	29.92	13.43	2.00	1.29	0.07	70.00	33.73	13.71	2.80	1.40	0.08
O ₄	I ₀	03.74	27.70	12.27	2.29	1.19	0.02	09.79	31.20	12.02	2.07	1.34	0.03
	I ₁	70.44	33.07	10.78	2.80	1.44	0.77	73.70	38.08	17.14	3.10	1.74	0.79
	I ₂	09.78	30.47	13.77	2.07	1.31	0.08	77.88	34.34	13.97	2.87	1.48	0.09
O ₅	I ₀	04.72	28.23	12.47	2.34	1.21	0.03	71.00	31.74	12.73	2.71	1.37	0.04
	I ₁	77.89	34.21	17.08	2.87	1.47	0.78	70.38	38.81	17.40	3.22	1.77	0.70
	I ₂	71.04	31.01	13.92	2.71	1.33	0.09	78.29	34.97	14.21	2.92	1.00	0.70
O ₆	I ₀	00.82	28.71	12.78	2.39	1.23	0.04	72.22	32.28	12.90	2.77	1.39	0.00
	I ₁	78.37	34.87	17.39	2.92	1.00	0.70	77.00	39.00	17.77	3.29	1.70	0.71
	I ₂	72.33	31.07	14.17	2.77	1.37	0.70	79.73	30.09	14.47	2.98	1.03	0.71
F. Test		ns			ns			ns			ns		
LSD 5%		-----			-----			-----			-----		
LSD 1%		-----			-----			-----			-----		
F. Test	S	**			**			**			**		
	O	**			**			**			**		
	I	**			**			**			**		
	OxI	**			**			**			**		
	SxI	*			*			**			**		
	S*O	ns			ns			*			*		

*Significant at 5% level.

** Significant at 1% level.

S_l = Low salinity.

S_m=Moderate salinity.

S_h = High salinity.

O₀= Without organic fertilizer

O₁=10 ton fed⁻¹ farmyard Manure

O₂=10 ton fed⁻¹ compost

O₃=10 ton fed⁻¹ poultry manure

O₄= 20 ton fed⁻¹ farmyard Manure

O₅=20 ton fed⁻¹ compost

O₆=20 ton fed⁻¹ poultry manure

I₀=Without inoculation

I₁=Azotobacter inoculate

I₂=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	4.09	1.71	0.77	0.32	0.09	10.47	0.21	1.77	0.87	0.37	0.10
	I ₁	11.27	0.09	2.10	0.93	0.38	0.12	12.78	7.40	2.22	1.07	0.44	0.12
	I ₂	10.93	0.30	1.97	0.90	0.37	0.11	12.34	7.09	2.02	1.02	0.42	0.11
O ₁	I ₀	9.49	4.77	1.73	0.81	0.33	0.10	10.77	0.30	1.79	0.91	0.38	0.10
	I ₁	11.01	0.70	2.19	0.98	0.41	0.13	13.07	7.03	2.27	1.12	0.47	0.13
	I ₂	11.17	0.44	1.99	0.90	0.39	0.11	12.70	7.20	2.07	1.08	0.44	0.12
O ₂	I ₀	9.78	4.70	1.77	0.87	0.30	0.11	10.89	0.39	1.82	0.97	0.40	0.11
	I ₁	11.77	0.80	2.23	1.04	0.43	0.13	13.30	7.70	2.30	1.18	0.50	0.14
	I ₂	11.40	0.04	2.03	1.01	0.41	0.12	12.87	7.31	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	0.48	1.80	1.02	0.43	0.12
	I ₁	12.02	0.91	2.27	1.10	0.47	0.14	13.70	7.78	2.30	1.20	0.53	0.15
	I ₂	11.74	0.74	2.07	1.07	0.44	0.13	13.14	7.42	2.13	1.20	0.50	0.13
O ₄	I ₀	10.07	4.91	1.83	0.90	0.40	0.12	11.33	0.08	1.88	1.07	0.40	0.12
	I ₁	12.29	7.03	2.32	1.17	0.49	0.15	13.90	7.91	2.39	1.32	0.57	0.17
	I ₂	11.89	0.74	2.10	1.13	0.47	0.14	13.42	7.04	2.17	1.27	0.53	0.14
O ₅	I ₀	10.28	4.99	1.87	1.01	0.42	0.13	11.07	0.77	1.92	1.13	0.48	0.13
	I ₁	12.07	7.14	2.37	1.23	0.52	0.17	14.27	7.04	2.44	1.40	0.59	0.17
	I ₂	12.14	0.80	2.14	1.19	0.49	0.15	13.70	7.77	2.21	1.34	0.57	0.15
O ₆	I ₀	10.48	0.08	1.89	1.07	0.44	0.14	11.79	0.77	1.90	1.20	0.50	0.14
	I ₁	12.84	7.27	2.40	1.30	0.50	0.17	14.07	7.17	2.48	1.48	0.63	0.18
	I ₂	12.39	0.90	2.18	1.27	0.52	0.17	13.99	7.78	2.20	1.42	0.59	0.17
F. Test		ns						*					
LSD 5%		-----						0.019					
LSD 1%		-----						0.025					
F. Test	S	**						**					
	O	**						**					
	I	**						**					
	Ox I	**						**					
	SxI	*						*					
	S*O	*						*					

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

S_h = High salinity.
 O₀= Without organic fertilizer
 O₁ =10 ton fed⁻¹ farmyard Manure
 O₂=10 ton fed⁻¹ compost

O₃ =10 tonfed⁻¹ poultry manure
 O₄= 20 ton fed⁻¹ farmyard Manure
 O₅ =20 ton fed⁻¹ compost
 O₆=20 ton fed⁻¹ poultry manur

I₀= Without inoculation
 I₁=Azotobacter inoculate
 I₂=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	9.70	0.04	2.30	0.97	2.22	1.27	10.97	7.29	2.42	7.71	2.78	1.40
	I ₁	11.42	7.09	2.98	7.98	2.97	1.72	12.97	7.00	2.08	7.92	4.02	1.78
	I ₂	10.80	7.11	2.72	7.70	2.77	1.02	12.18	7.97	2.71	7.40	4.18	1.07
O ₁	I ₀	9.90	0.72	2.29	7.29	2.02	1.44	11.19	7.40	2.47	7.08	4.00	1.49
	I ₁	11.77	7.71	2.04	7.28	4.20	1.84	12.20	7.79	2.14	8.28	4.81	1.90
	I ₂	11.02	7.22	2.77	7.97	2.89	1.71	12.44	7.09	2.77	7.87	4.42	1.77
O ₂	I ₀	10.10	0.72	2.42	7.74	2.72	1.02	11.41	7.01	2.01	7.47	4.22	1.08
	I ₁	11.92	7.84	2.10	7.81	4.40	1.97	12.04	7.84	2.20	8.87	0.70	2.02
	I ₂	11.27	7.24	2.72	7.27	4.12	1.22	12.70	7.21	2.80	8.21	4.99	1.77
O ₃	I ₀	10.20	0.82	2.47	7.01	2.97	1.22	11.74	7.22	2.00	7.88	4.48	1.78
	I ₁	12.20	7.97	2.77	8.27	4.22	2.08	12.84	7.99	2.27	9.27	0.41	2.10
	I ₂	11.49	7.40	2.77	7.78	4.27	1.82	12.97	7.24	2.87	8.78	4.97	1.88
O ₄	I ₀	10.07	0.92	2.01	7.40	4.17	1.22	11.88	7.22	2.09	8.22	4.24	1.79
	I ₁	12.47	7.10	2.22	8.22	0.00	2.22	14.10	8.14	2.22	9.91	0.22	2.29
	I ₂	11.74	7.07	2.82	8.22	4.22	1.94	12.20	7.48	2.91	9.28	0.27	2.00
O ₅	I ₀	10.77	7.02	2.07	7.81	4.42	1.84	12.12	7.84	2.74	8.78	0.22	1.90
	I ₁	12.74	7.24	2.28	9.24	0.21	2.27	14.47	8.20	2.29	10.28	7.08	2.44
	I ₂	11.98	7.79	2.87	8.79	4.90	2.07	12.02	7.71	2.97	9.80	0.08	2.12
O ₆	I ₀	10.99	7.12	2.70	8.24	4.78	1.90	12.27	7.97	2.78	9.27	0.21	2.02
	I ₁	12.02	7.28	2.24	9.27	0.72	2.01	14.78	8.20	2.40	11.08	7.40	2.70
	I ₂	12.24	7.81	2.92	9.18	0.19	2.19	12.81	7.70	2.01	10.27	0.91	2.27
F. Test		*						*					
LSD 5%		0.160						0.137					
LSD 1%		0.211						0.180					
F. Test	S	**						**					
	O	**						**					
	I	**						**					
	Ox I	**						**					
	SxI	**						**					
	S*O	*						*					

*Significant at 5% level.
 ** Significant at 1% level.
 S_l = Low salinity.
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 O₀= Without organic fertilizer
 O₁ =10 ton fed⁻¹ farmyard Manure
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O₃ =10 tonfed⁻¹ poultry manure
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 O₅ =20 ton fed⁻¹ compost
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I₀= Without inoculation
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