Influence of Organic compost, Proline and the Biofertilizer (Salinity Durable Bacteria) on Barley Growth and Nutrients Uptake under High Salinity Conditions

Abbas, Y.M[*] and Ewees, M.S.A.[**]

*Soils, Water and Environment Res. Institute, Agric. Res. Center, Giza, Egypt.

**Soils, Water and Department, Fac. of Agric., El-Fayoum University.

ABSRACT

A filed experiment was carried out on salt affected soil at Kasr El-Basel village, wast Etsa district, El-Fayoum Governorate, Egypt, during the winter season 2014/2015. Objective of this work was to study the effects of applied local compost at a rate of 20 m^3 fed^{-1}, amino acid (proline) sprayed at rate of 3 mg/L fed^{-1} at 20, 45, and 60 days after sowing) and biofertilizer (salinity durable bacteria) as either solely or combined treatments on barley (*Hordeum vulgare,* c.v. Giza 123) growth and yield parameters. The experimental field was irrigated with saline water (a mixture of the fresh Nile water and agricultural drainage water). The quality of the used irrigation water was classified as C2S1 (ECiw = 1.66 dS/m and SAR 5.35). The influence of treatments on some soil properties (soil pH, ECe, ESP and available macro and micronutrient contents) was studied.

Obtained results indicated that, the values of EC, ESP and pH, decreased however, the organic matter and CEC increased with the application of compost, proline and biofertilizer, the best treatment was found to be (OM + proline + BF) .The application of (OM + proline + BF) also, decreased soil bulk density, while increased hydraulic conductivity , total porosity and soil moisture content . Plant height, numbere of grains/ spike, number spikes / m^2, 1000 grains weight, and grain and straw yields were also, improved with treatments. The greatest values were associated with the triple combined treatment (OM + proline + BF) as compared to the other combined or solely ones.

It could be recommended that compost, proline and the biofertilizer (salinity durable bacteria) could be used to alleviate the hazardous effects of either soil or water salinity, which negatively affect barley seed yield and quality.

Key words: Compost, Amino acids, Proline, Biofertilizers, Salinity durable bacteria, Barley, plant growth and quality parameters.

INTRODUCTION

Soil management is usually carried out through the addition of natural soil amendments and biofertilizers that have become one of the most important practices for improving soil hydrophysical, chemical and biological properties and in turn enhancing its productivity for different vegetable crops.

Salinity is one of the major problems of agriculture in arid and semi-arid regions, such as Eygpt. Egypt is one of the countries that suffer severe salinity problems. About 33% of the cultivated land, which comprises only 3% of total land area in Egypt are saline. Such salinity is mainly due to low precipitation (< 25 mm annual rainfall), high temperature (that ranges from 35 to 45°C), high surface evaporation (1500- 2400 mm/year), poor drainage in about 98% of the cultivated land under irrigation, high water table (less than one meter below the soil surface), and irrigation with low quality saline water (up to 4.5 dS/m). Salt stress generally leads to a reduction in biomass production owing to a dimintion of the water potential, specific ion toxicities, or nutrient deficiencies **(Parida and Das, 2005).**

Reduction in salt affected soils productivity is due to the high osmotic potential in solution within the crop root zone, which causes disturbances in nutrients balance, reduces either soil available nutrients or water uptake by roots of growing plants and consequently reduces the quality and yield of crops **(Ayers and Westcot, 1985).**

The harmful effect of salinity stress is also attributed to an ionic imbalance in plant cells due to the excessive accumulation of Na^+ and Cl^- that result in a reduction in K^+, Ca^{2+} and Mn^{2+} uptake **(Tester and Davenport, 2003**). Plant response to fertilizers depends on severity of salt stress in the root zone and fertilizers application to saline soils may exacerbate soil salinization **(Maas and Grattan, 1999).**

Barley is one of the salt-tolerant crops and they are becoming increasingly important crops in many regions of the world including Egypt. Where its tolerate adverse conditions such as salinity, heat, drought, and low soil fertility. Barley is of great economic importance in salt-affected arid and semiarid regions of the world.

Several investigators studied the effect of compost, proline and bio-fertilizers (salinity durable bacteria) in decreasing soil salinity effects. **Khaled *et al.*, (2011)** reported that the role of compost in salt-affected soils is very vital because the organic source is ultimate opportunity to improve the physical properties of soils, which have been deteriorated to the extent that water and air passage become extremely difficult in such soils. Also, tea compost has been used to improve the properties of soil and reduce salinity problems, as well as to improve plant growth **(Sunjeong *et al.*, 2010**).

Proline amino acid plays an adaptive role in the tolerance of plant cells to salinity by increasing the concentration of cultural osmotic components in order to equalize the osmotic potential of the cytoplasm. **(Wareing and Phillips, 1978, and Wated *et al.*, 1983).**The increase in proline content in plant tissues with the increase in salinity retards protein synthesis, and consequently accumulates free amino acids, including proline**(Wated *et al.*, 1983, Ouerghi *et al.*, 1991, Zidan and Malibari, 1993, Barakat and Abdel-Latif, 1995, Yurekli *et al.*, 1996, and El-Leboudi *et al.*, 1997)**. In this connection, **Wageeh (1994)** reported that the best treatments which gave the most favorable response for growth by wheat plants were seed soaking for 12 hours interval in solutions of 5 ppm from each of the following amino acids: proline, glutamic acid and aspartic acid compared with soaking in distilled water.

Torello and Ricf (1986) and **Tipiramaz and Cakirlar (1990)** found that the accumulation of proline was rapid in barley.

Beneficial soil microorganisms such as PGPR showed positive effects in plants, particularly on parameters such as the rate of germination, tolerance to drought and salinity and the weight of stems and roots. **(Silini *et al.*, 2012).**

The inoculation with salt-tolerant strains improves plant growth as compared with the effect of salt-sensitive strains **(Zou *et al.*, 1995).**

The objective of the present work was to study possibility of alleviating the harmful effects soil salinity on barley plants growth and yield by the application of compost, proline amino acid and inoculation with salinity durable bacteria.

MATERIALS AND METHODS

The objective of the present work was to study possibility of alleviating the harmful effects soil salinity on barley plants growth and yield by the application of compost, proline amino acid and inoculation with salinity durable bacteria. To achieve the aforementioned target, a filed experiment was carried out on salt affected soil at kasr El-Basel village, wast Etsa district, El-Fayoum Governorate, Egypt, during the winter season 2014/2015. Compost was applied at a rate of 20 m^3 fed^{-1}, as individual or combined with proline sprayed at rate of 3 mg/L fed^{-1} at 20, 45, and 60 days after sowing. Salinity durable bacteria was provided by the Bio-fertilizer Production Unit, Department of Microbiology, Soils, Water and Environment Research Institute, Agric. Res. Center, Giza. The seeds were soaked with Azospirillum and Azotobacter at rate 600 gm/fed.

The experimental soil was irrigated with saline water (a mixture of the fresh Nile water and agricultural drainage water) which could be classified as (C2S1), denoting increase problems for soil salinity (C2) is expected. The chemical characteristics of irrigation water were carried out according to the described methods and suitability criteria for irrigation after **Page *et al.* (1982) and Ayers and Westcot (1985)**, respectively, as shown in Table (1).

Chemical analysis of compost used are presented in Table (2). The experimental plots were arranged in a combined split plots design with three replicates. The area of each plot was 10.5 m^2 (3.0 m width x 3.5 m length). Plots were ploughed twice in two ways after the adding of superphosphate fertilizer (15.5 % P_2O_5) at a rate of 100 kg fed^{-1}. All treatments received a similar fertilization with recommended dose of nitrogen in the form of ammonium nitrate (33.5 % N) at the rate of 134 kg N/fed for barley in to equal doses during the growing period, i. e., after 15 & 40 days from plantation Also, potassium sulphate (48 % K_2O) was added at a rate of 50 kg fed^{-1} in two equal doses, *i.e.,* after 15 and 40 days from planting.

Treatments were as follows:

1. Control (c)
2. Compost at rate of 20 m^3/fed.
3. Proline sprayed at rate of 3 mg/L at 20, 45, and 60 days after sowing.
4. Biofertilizer (salinity durable bacteria): the seeds were soaked with Azospirillum and Azotobacter at rate 600 gm/fed.
5. Compost + Proline
6. Compost + Biofertilizer

7. Proline+ Biofertilizer

8. OM + Proline + Biofertilizer

Table (1): Chemical properties of used irrigation water of Baher El-Ghark

pH	EC dSm^{-1}	Soluble ions ($meq\ L^{-1}$)							SAR	*Irrigation water quality
		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_{3-}	Cl^{-}	$SO_4^{\ 2-}$		C2S1
8.40	1.66	3.07	4.29	8.16	0.41	3.83	6.74	5.36	4.25	

According to* ***Ayers and Westcot (1985)* *scale.*

Table (2): Physical and chemical properties of the **compost used.**

EC dSm^{-1} (1:10)	pH (1:10 water suspension)	Total NPK (%)			C/N ratio	Organic matter (%)	Available micronutrients ($mg\ kg^{-1}$)			
		N	P	K			Fe	Mn	Zn	Cu
2.45	7.6	1.51	0.66	1.86	16	35.7	79.63	36.42	24.83	9.75

Barley was planted in winter season 2014/2015 and harvested at maturity stage to determine the yields of grains and straw. Harvest Of barley crop was done after 140 days from sowing. At harvest, the grains were separated from the vegetative part (straw) and the weights of 1000 grain and straw per plotswere recorded as dry weight. The obtained straw and grain from 1.0 m central area of all experimental plots were analyzed separately for N, P, and K.

Soil samples were collected from the surface layer (0-30 cm) before starting treatments and at the end of vegetative growth (80 day after plantation), then dried, crushed and sieved through a 2 mm screen. Samples were analyzed to measure the electrical conductivity (EC_e) and pH (**Jackson, 1973).** Particle size distribution and calcium carbonate were determined according to **(Piper, 1950).** Soil organic matter was determined according to Walkley-Black method **(Black et al., 1965).** Cation exchange capacity was determined by using method of **(Richards,**

1954). Physical and chemical analyses of the studied soil before cultivation are shown in Table (3) .Plant samples (grain and straw) were taken after harvest and digested to determine their contents of N, P, K according to **Chapman and Prrate, (1961).** Available macronutrients of N, P and K in soil were extracted by 1% potassium sulphate, 0.5 M sodium bicarbonate and 1 N ammonium acetate, respectively **(Soltanpour and Schwab, 1977)** and their contents in soil were determined according to **Jackson (1973).** Available micronutrients of Fe, Mn, Zn and Cu in soil were extracted using am monium bicarbonate-DTPA extract according to **Soltanpour and Schwab, (1977)** and their contents in soil were measured by using the Atomic Absorption Spectrophotometer.

Data obtained of the tested plant characters were subjected to statistical analysis according to **Snedecor and Cochran (1980)** to define the least significant difference test (L.S.D. at *p*=0.05 level), which was used to verify the differences between the tested treatments.

Table (3): Some physical and chemical characteristics of the experimental soil:

Soil characteristics	Value	Soil characteristics.	Value
Particle size distribution %		ESP%	12.46
Coarse sand	5.80		
Fine sand	14.80	*Soluble ions in soil paste extract (m molc L^{-1}):*	
Silt	30.10	Ca^{++}	31.24
Clay	49.30	Mg^{++}	22.17
Soil texture class	Clayey	Na^{+}	57.47
$CaCO_3$ %	2.48	K^{+}	1.60
Organic matter %	0.86	CO_3^{--}	0.00
ECe in dSm^{-1} (Soil paste):	11.33	HCO_3^{-}	2.78
pH (*Soil paste extract*):	7.87	Cl^{-}	61.81
		SO_4^{--}	47.89

Available macro and micronutrients (mg/kg soil)						
N	P	K	Fe	Mn	Zn	Cu
80.00	4.50	152	4.32	0.92	1.46	0.43

Critical levels of nutrients after Lindsay and Norvell (1978) and Page et al. (1982)							
Limits	N	P	K	Fe	Mn	Zn	Cu
Low	< 40.0	< 5.0	< 85.0	< 4.0	< 2.0	< 1.0	< 0.5
Medium	40.0-80.0	5.0-10.0	85.0-170.0	4.0-6.0	2.0-5.0	1.0-2.0	0.5-1.0
High	> 80.0	> 10.0	> 170	> 6.0	> 5.0	> 2.0	> 1.0

Results and Discussion

I. A general view on the experimental soil:

The results obtained of particle size distribution, Table (1), reveal that the studied soil is characterized by fine texture (clayey), and it attains low content of $CaCO_3$ and organic matter. The later may be ascribed to the prevailing hot and arid climatic conditions. Also, the studied soil has relatively low values of sodicity (*i.e.,* ESP, non-alkali soil) and ECe more than 4 dSm^{-1}, which led to classified the studied soil as saline and non-alkaline. Such results are emphasized by the positive effects of the progressive increments of soluble Na^+ which surpassed the soluble content of Ca^{2+} + Mg^2 contents that reflected the signs of unfavourable soil aggregation, with weak granular as a structure type.

II. Response of some soil chemical properties and available nutrient contents to the applied treatments:

a. Soil physical and chemical characteristics:

The effects of organic compost added either solely or combined with proline and biofertilizer to the experimental soil plots under cultivation with barley, caused a pronounced ameliorated effect on each of the studied soil characters, i.e., soil bulk density, hydraulic conductivity, total porosity, field capacity, welting point and available water as shown in Table (4).

Data in Table (4) indicated that the application of compost and/or biofertilizer (salinity durable bacteria) resulted in decreases in the values of soil bulk density, ECe, pH and ESP. On the other hand, each of total porosity%, field capacity%, wilting point%, available water%, hydraulic conductivity, organic matter% and CEC were increased with the application of either compost or biofertilizer separately or in combination. The application of (OM + proline + BF) resulted in the greatest effect on each of the studied properties in comparison with the control and the one of each of them alone. The results are in agreement with those obtained by **Sunjeong *et al*., (2010**) reported that compost tea has been used to improve the soil properties of the soil and reduce salinity problems.

***b. Soil available macro and micronutrient contents**:*

The magnitudes of available nutrients extracted with in the soil before treatments, Table (2) showed that the studied nutrients (N, P, K, Fe, Mn and Zn) lay within the low-medium range, according to the critical levels of nutrients reported by **Lindsay and Norvell (1978).** In general, this is true since this soil is not only poor in the nutrient-bearing minerals, but also in organic matter content, which are considered as storehouse for the essential plant nutrients. On the other hand, data illustrated in Table (4) indicated that available con concentrations of the studied macro- (N, P and K) and micronutrients (Fe, Mn and Zn) in the studied soil irrigated with the tested saline water were drastically negatively affected by the excess salts in soil, but their contents gradually increased with applied organic compost and biofertilizer. These results are in agreement with those obtained by many investigators on different field crops, such as **Abou Zied *et al,.* (2005), Basyouny (2005) and Hala *et al., (*2002)** showed that vermicomposting is good supplemental sources of readily available P and K, as well as for N.

The relative increase in available nutrient concentrations may be attributed to the modified suitable air-moisture regime that control the availability of nutrients, in addition to the effect of applied organic compost in alleviating the depressive effect of salinity stress on released nutrients from either organic residues or nutrient bearing minerals.

The integrated role of applied organic compost with bio-fertilizer could be also due to the released active organic acids during microbial activity that enhance the solubilization of nutrients from the native and added sources, also may be attributed to their slow release during the decomposition and mineralization processes as well as minimizing their possible lose by leaching throughout the studied relatively coarse texture soil **(Nader and Ewees, 2011).**

On the Other hand, application of proline had a slightly affected on soil proporties. These results are in accordance with those obtained by **Torello and Ricf (1986)** who mentioned that accumulation of proline was rapid in barley that adapted to applied salinity.

Data in Table (4) indicated that the superiority of combined effects of applied organic compost, bio-fertilizer and proline treatments for the noticeable reduction in the values of soil pH, ECe and ESP vs a pronounced increase in soil organic matter content, CEC and soil available nutrient concentrations and biological conditions that enhancing nutrients uptake by plants could be interpreted as follows:

i. Organic compost decomposition tends to accelerate in the presence of microbial media of bio-fertilizer, and in turn produces active organic and inorganic acids that may led to decrease soil pH as well chelate metals (Fe, Mn and Zn). These chelated metal cations are not sensitive to the restriction or the adverseable effects of alkaline side, consequently they are found as strategic storehouse in organo-metalic compounds that are more suitable for uptake by plant roots.

ii. The effective role of microbial activity to reduce soil salinity stress, particularly in combination with either organic or biofertilizer, could be interpreted according to many opinions outlined by **Ashmaye *et al.*, (2008)** reported that many strains produce several phytohormones (i.e., indole acetic acid and cytokinins) and organic acids. Such products reduce the deleterious effect of Na-salts, and simultaneously improve soil structure, i.e., increasing aggregate stability and drainable pores. Consequently, these created conductive pores enhance the leaching process of soluble salts through irrigation fractions.

Table (4): Effect of treatments on some soil properties and available nutrients concentrations.

Soil properties & nutrients status	**Applied treatments**									
	Control	OM	Proline	BF	OM + Proline	OM+ BF	Porline + BF	OM+BF+ Proline	**Mean**	Statistical analysis (L.S.D. at 0.05)
Bulk density (g/cm^3)	1.33	1.26	1.32	1.29	1.25	1.22	1.28	1.21	**1.27**	0.01
Hydraulic conduct. (cm/hr)	0.44	1.14	0.45	0.65	1.17	1.56	0.67	1.58	**0.96**	0.06
Total porosity (%)	54.75	58.46	54.80	55.32	59.09	62.81	55.48	63.19	**57.99**	0.94
F.C. (%)	37.40	38.67	37.37	37.67	39.07	40.17	38.43	40.23	**38.63**	1.42
W.P. (%)	17.30	16.95	17.23	17.09	16.74	16.59	17.02	16.25	**16.90**	0.77
A.W. (%)	20.10	21.72	20.14	20.58	22.35	23.58	21.41	23.98	**21.73**	1.57
ECe (dS/m)	11.33	9.16	11.33	10.61	9.09	8.28	10.57	8.24	**9.83**	0.73
pH	7.87	7.63	7.86	7.79	7.62	7.51	7.77	7.49	**7.69**	0.10
OM%	0.86	2.05	0.87	1.26	2.12	2.36	1.30	2.39	**1.65**	0.06
ESP%	12.46	9.32	12.43	11.26	9.29	8.21	11.24	8.17	**10.30**	0.87
CEC (Meq/100g soil)	40.17	45.53	40.00	41.97	46.29	50.90	42.20	51.30	**44.80**	3.72
Available macro and micronutrients (mg kg^{-1})										
N	118	165	114	133	170	193	135	196	153.62	7.16
P	4.5	11.7	4.60	6.80	11.80	13.80	6.90	13.90	**9.25**	0.89
K	152	187	153	165	190	214	168	217	**180.50**	6.49
Fe	4.32	10.94	4.33	6.53	11.11	11.58	6.65	6.78	**7.78**	0.66
Mn	0.92	2.05	0.93	1.30	2.14	3.09	1.34	3.18	**1.87**	0.1
Zn	1.46	1.84	1.48	1.58	1.87	2.13	1.61	2.16	**1.77**	0.07

F.C= Field capacity, W.P= Welting point, A.W= Available water,
OM=Organic compost and BF=Bio-fertilizer

III: Plant parameters as affected by treatments:

a. Plant growth characters, grain and straw yields:

Data presented in Table (5) indicate that the achieved favourable soil conditions due to the applied treatments, particularly the combiation ones of compost with either bio-fertilizer (salinity durable bacteria) or foliated with proline, were positively reflected on the studied values of barley plants growth parameters (*i.e.* plant height, No of grains/ spike, and No spikes/m^2), biological yield (grain and straw yields) and some parameters of grain quality (1000 grain weight) of barley plants grown in salt affected soil as compared to the applied solely ones.

It could be noticed that from data in Table (5) plots that received the combination of (OM + proline + BF) produced higher growth parameters (plant height, number of grains/spike and number spikes/m^2) than the control and the previous materials with corresponding values of 102.40 cm for plant height, 46.00 number of grains /spike and 287 number of spik /m^2. Increases in these characters due to the application of (OM + proline + BF), the percentage of these values reached to 40.27, 53.33 and 32.87 % for plant height. number of grains/ spike and number spikes/m^2 respectively, compared with that of control. No significant differences were observed between (OM + proline + BF) application and without proline supplement.

Data presented in Table (5) revealed that the, biological yield (grain and straw yields) and some parameters of grain quality (1000 grain weight) were substantially improved by the application of compost in combination with either (salinity durable bacteria) or foliated proline.

Results presented in Table (5) showed that grain, straw yields and 1000 grain weight were significantly increased by the application of different materials as single or in combination, but no significantly between OM + BF and (OM + proline + BF). The highest yields of grain, straw and 1000 grain weight were associated with barley plants received (OM + proline + BF) treatments, values were 2378.4 kg/fed, 5.63 ton/fed and 52.06 g, respectively. These values represented 156.73, 155.90 and 20.59% of that of the control, respectively. Either organic compost addition or biofertilizer with proline had a significant increase on grain, straw yields and1000 grain weight (Table 5). These results are also in the line with those obtained by **Nader and Ewees (2011)** stated that some bacteria such as arbuscular mycorrhizal (AM) fungi is capable to produce some hormones which induces the proliferation roots and root hair that increase nutrient absorbing surfaces as well as produce organic acids, which solublize inorganic and organic forms of mineral elements.

Wated *et al.,* (1983) reported that proline amino acid plays an adaptive role in the tolerance of plant cells to salinity by increasing the concentration of cultural osmotic components in order to equalize the osmotic potential of the cytoplasm.

Table (5): Effect of treatments on growth parameters, grain and straw yields of barley grown on salt affected soil.

Growth parameters and plant yields	**Applied treatments**									
	Control	OM	Proline	BF	OM + Proline	OM+ BF	Porline + BF	OM+BF+ Proline	**Mean**	Statistical analysis (L.S.D. at 0.05)
Plant height (cm)	73	101.20	97.20	100.80	101.39	102	101.30	102.40	**97.41**	3.82
No.of grains/spike	30	38	34	38	43	44	39	46	**39.04**	7.92
No . Spike/m^2	216	257	246	252	267	275	267	287	**258.40**	10.44
1000-grains weight (g)	43.17	48.52	46.22	48.40	48.81	50.35	49.05	52.06	**48.32**	3.35
Grain yield (kg/fed)	926.40	2059.20	1623.6	1707.6	2174.4	2347.2	1780.8	2378.4	**1874.4**	0.83
Straw yield (ton/fed)	2.20	4.93	3.87	4.06	5.16	5.58	4.25	5.63	**4.46**	0.50

OM=Organic compost and BF=Bio-fertilizer

b. Nutrient contents in barley grains as affected by treatments:

Data of the studied macro-nutrients (N, P and K) and micronutrients (Fe, Mn and Zn) contents in barley grains are presented in Table (6). The obtained results exhibited pronounced concentrations increases for the studied macro and micronutrients due to the applied compost as a solely treatment, the greatest values were observed when it was combined with both proline and biofertilizer, followed by the combined treatments of (OM+BF) and (OM+proline) as compared to the control treatment (untreated soil). Undoubtedly, the applied solely and some combined treatments were useful for released available nutrients, and in turn their contents in plant tissues. Such surpassed effect of organic compost in the combined treatments is more associated with the relatively high contents of both essential macro- and micro-nutrients (N, P, K, Fe, Mn and Zn), the released active organic acids that enhance more released micronutrients or their solubilization from both native or added sources.

In general, the favourable effect of the combined treatments attained organic compost or byiofertilizer was commonly achieved may be due to lowering soil pH that improve nutrients availability, mobility and ability to uptake by plant roots. In addition, the superiority of applied treatments attained (OM + proline + BF) were more attributed to their richness in organic substances that ameliorate soil-moisture regime and the biological soil condition. This beneficial effect could be explained by many aspects, *i.e.*, increasing the released either macro- or micro-nutrient contents through the decomposition of the applied compost, reduction of nutrient fixation and forming the stable complexes of micronutrients-humic substances supplied from such manures and keeping them in available forms for extended period **(Ewees, 2012)**.

On the other hand, the significant response of nutrients contents in barley grain to biofertilizer and soil application of organic compost may be due to increased root growth that enable the grown plants to absorb more nutrients. **Kloepper (2003**) pointed out that phytohormones producer bacteria causes pronounced increases for plant root elongation by then uptake of more nutrients via the root system, and hence utilization of N as a result of bio-inoculation. **Nader and Ewees (2011)** reported that biofertilizer increased uptake of N, P, K, Fe, Zn, and Mn by plants.

It could be concluded that, the combined treatment of (OM + proline + BF) exhibited a superior effect due to improving soil physico-chemical properties positively affect the nutrients availability as well as maintaining a suitable soil moisture regime**.** It is noteworthy to mention that the nutrient contents in plant tissues were, in general, extending parallel close to the corresponding available nutrient contents in the studied soil, as shown in Tables (4).

Table (6): Effect of treatments on nutrient contents of Barley grown on salt affected soil.

applied treatments	Grain content of macro and micro nutrients	
	Macronutrients (mg kg-1)	Micronutrients (mg kg-1)

	N	K	P	Fe	Mn	Zn
Cotrol	1.63	1.11	0.41	142	57.80	47.50
OM	1.91	1.31	0.50	171	71.00	63.00
Proline	1.73	1.21	0.42	159	62.40	50.90
BF	1.82	1.28	0.48	163	66.70	54.60
OM + Proline	1.85	1.33	0.51	189	77.70	70.00
OM + Bio	2.10	1.38	0.64	210	88.00	82.00
Proline + BF	1.76	1.30	0.49	175	70.00	60.00
OM + Proline + BF	2.16	1.44	0.68	216	93.00	87.00
Mean	**1.87**	**1.30**	**0.52**			
L.S.D, at (0.05)	0.06	0.05	0.06	0.09	0.56	0.62

OM=Organic compost and BF=Bio-fertilizer

IV: Crude protein and carbohydrates in barley :

Data in Table (7) showed a markedly positive and significant effects were achieved due to applying both combined treatments of (OM + proline + BF), (OM + BF) and (OM). Such effect was achieved upon the significance of L.S.D. values at 0.05.

Relative to the control, single treatments OM, proline and BF resulted in 12.51, 15.25 and 24.36%, increases in crude protein (%) percentage, and gave 10.28, 0.21 and 2.50% carbohydrate content (%), respectively (Table 7). Relative to control, combination treatments OM + proline+ BF, OM + BF, OM + proline and proline + BF resulted in increases of 19.53, 33.47 and 15.03%for crude protein (%) and 5.46, 4.24 and 3.30% for carbohydrate content (%), respectively .

Table (7): Effect of materials on Crude Protein (%), Carbohydrate content and in Barley plants on salt affected soil.

Applied treatments	**Carbohydrate content (%)**	**Crude Protein (%)**
Cotrol	13.90	9.11
OM	15.33	10.25
Proline	13.93	10.50
BF	14.25	11.33
OM + Proline	14.49	10.89
OM + Bio	14.66	12.16
Proline + BF	13.44	10.48
OM + Proline + BF	15.29	13.13
Mean	**14.41**	**10.98**
L.S.D, at (0.05)	0.73	0.78

OM=Organic compost and BF=Bio-fertilizer

Results of the present work emphasized the possibility of alleviating the harmful effects of high soil salinity on barley plants growth, yield, grain quality and absorption of nutrients by the application of compost, proline amino acid and inoculation with salinity durable bacteria.

REFERENCES

Barakat, M.N. and Abdel-Latif, T.H. (1995). In vitro selection for salt-tolerant lines in wheat. II. In vitro characterization of cell lines and plant regeneration. Alex. J. of Agric. Res. 40: 139-165.

Black, G.R., Evans, D.D., Ensminger, L.E., White, J.L. and Chark, F.E.(1965)."Methods of soil analysis" Agron. Series , AM. Agron., Madison, Wisconsin, USA.

Chapman, H. D. and Pratt, P. F. (1961). Methods of Analysis for Soils, plant and water. Univ. California, Division of Agric. Sci., Berkeley, CA 94720.

El-Leboudi, A.E., Gawish, Sh.M., Abdel-Aziz, S.M. and Ahmed, M.R.M. (1997). Some metabolic aspects in wheat plants subjected to salinity. Annals of Agric. Sci. Cairo.42: 585-596.

Jackson, M. L. (1973). "Soil Chemical Analysis", Constable Co., Itd., London.pp. 521.

Khaled, A.S.; Mona, G.A. and Seham, M.E. (2011). Evaluation of organic farm and compost combined with urea fertilizers on fertility and maize productivity in newly reclaimed. Research J. of Agric, and Biol. Sci., 6(5): 388 – 397.

Ouerghi, Z., Zid, E. and Ayadi, A. (1991). Sensitivity to NaCl and exclusion of Na^+ in sunflower *(Helianthus annuus)*. Agric. Mediterranea. 121:110-114.

Parida. A. K and A. B. Das (2005). Salt tolerance and salinity effects on plants. Ecotox. Envirion. Saf. 60, 324-349.

Piper, C. S. (1950)."Soil and Plant Analysis" A monograph from the wails agric. research Inst., University of Adelaide Australia.

Richards L.A.(1954). Diagnosis and Improvement of Saline and Alkali soils. United. States Department of Agriculture. Handbook No. 60. Gov. print off.

Salah, E. E. (2004). Salinity Tolerance in Egyption spring Wheat Genotypes. PH.D. thesis, TechnischeuniversitatMunchen.

Silini, A.; Silini-Cherif, H. and Ghoul, M. (2012). Effect of *Azotobactervinelandii* and compatible solutes on germination wheat seeds and root concentrations of sodium and potassium under salt stress. Pak. J. of Biol. Sci. 15(3): 132-140.

Sudhir, K. U.; Sanjeev, K. M. and Devendra, P. S. (2012). Salinity tolerance in free living plant growth promoting rhizobacteria. Indian J. Sci. Res. 3(2): 73-78.

Sunjeong P.; Chunxue C. and Brain B. M.G. (2010). Inoculants and soil amendments for organic growers. Agriculturals and Natural resources. 10- 17.

Tipiramaz, R. and Cakirlar, H. (1990). Effect of water and salinity stress on relative water content, proline and betaine composition in two varieties of wheat plants cultivated in Turkey, Doga. Bigoloja. Serisi. 14: 124 –148 .

Torello, W.A. and Ricf, L.A. (1986). Effects of NaCl stress on proline and cation accumulation in salt sensitive and tolerant turfgrass. Plant and Soil. 93:241-247.

Wageeh, M. G. M. (1994). Effect of some treatments on salt tolerance of plants. Ph.D. Thesis, Fac. of Agric. Moshtohor. Zagazig. Univ.

Wareing, P.E. and Phillips, I.D.J. (1978). The control of growth and differentiation in plant. Second Edition, Chap. 3 and 4, Great Britain, by WillianClowes and Sons Limited, London.

Wated, A., Reinhard, E.L. and Lerner, H.R. (1983). Comparison between a stable NaCl selected Nicotiana cell line and the wild type, Na, K and proline pools as a function of salinity. Plant physiol. 73: 624-629.

Yurekli, F., Topcuoglu, S.F. and Bozcuk, S. (1996). Effects of salt stress on proline accumulation in sunflower leaves in relation to salt concentration and duration of stress. Turkish. J. of Biology. 20: 163-169.

Zou, N.; Dart, P.J. and Marcar, N.E. (1995). Interaction of salinityand rhizobial strain on growth and N_2-fixation by Acaciaampliceps. Soil Biol. Biochem. 27 (415): 409-413.

Zidan, M.A. and Malibari, A.A (1993). The role of K in alleviating stress affecting growth and organic and mineral components of wheat. Arab Gulf. of Sci. Res. 11:201-208.