The Role of Some Bio-stimulants on Yield Characters and Grain Chemical Composition of Maize Grown Under Saline Soil Conditions

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ABSTRACT: Field experiment was conducted on maize at the Experimental Farm of the Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt, during the growing season of 2017 for evaluating the role of some bio stimulants on yield characters and grain chemical composition of maize grown under saline soil conditions. The experiment was designed as completely randomized block design with three replicates. Each replicate contained the following treatments: seaweed extracts (0, 1, 2, and 3 ml/l), proline acid (0, 0.1, 0.2, and 0.3 g/l), dry yeast (0, 20, 40, and 60 g/l), humic acid (0, 1, 2, and 3 g/l) and compost tea (0, 5, 10, and 15 ml /l). The results indicated that, the compost tea at the concentration of 15 ml/l, gave the highest mean values of grain yield (5.59 t/fed), harvest index, the nutrients (N, P, K) and protein contents in grains. Also, the results revealed that the plant treated with humic acid, particularly, at 3 g/l was more superior for yielding (13.03 t/ fed) grains in addition to (7.93 t/fed) straw. Documented data on proline proved that the maximum, straw yield (7.93 t/fed) was achieved at the application rate of 0.3 g/l. In the same time, the Na concentration decreased in the grains with increasing the concentration of each bio stimulant. In contrast of the highest level of proline application, minimum Na content in the grain yield was realized. The N, P, K and Na status of soil did not appear any significant variations among the different applied levels of the stimulatory sources.

Keywords: maize, soil salinity, seaweed, proline, compost tea, humic acid, dry yeast, yield

INTRODUCTION

In Egypt, maize is one of the major cereal crops, where as it is mixed with wheat in the bread industry. Much attention is being focused on increasing grain yield potential for meet the gap between the local production and human consumption, by selecting new crop cultivars at the most favorable environmental conditions (Tolba *et al.,* 2010). Maize (*Zea mays* L.) is the second staple food after rice, but the growth of maize is very susceptible to salinity with tolerance levels of 1.5 – 2.0 dS/m (Mindari *et al.,* 2011).

Soil salinity is a major concern to agriculture all over the world because it affects almost all plant functions. It impedes plant performance by inducing deleterious effects on germination and plant vigor. In Egypt, the majority of salt-affected areas are located in the northern central part of the Nile Delta and on its eastern and western sides. Stress tolerance is a complex trait that is controlled by multiple genes and involves different physiological and biochemical mechanisms (Zhang and Shi, 2013). Osmoprotectants or bio stimulants as foliar application can be an economically viable strategy for improving tolerance of stress under adverse environmental conditions (Abdelhamid *et al.*, 2013, Sadak and Mostafa, 2015 and Sadak, 2016).

Bio-stimulants are an organic material that has been shown to influence several metabolic processes such as respiration, photosynthesis, nucleic acid synthesis and ion uptake and when applied in small quantities, enhances plant growth and development. They may enhance water-holding capacity, increase antioxidants, and enhance metabolism (Snedecor and Cochran 1980). Seaweeds contain all the micro and macro nutrient and plant growth hormones required by plant to enhance yield attributes (Abd El-Moniem and Abd-Allah 2008, Latique *et al.,* 2013). Seaweed extracts have been used in agriculture and horticulture as bio-stimulants to promote plant growth and increase crop yields (Stamatiadis *et al.*, 2015). Active dry yeast is a natural safety bio fertilizer, and it is considered as a natural source of cytokinins that stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid. The use of yeast as a bio-fertilizer in agriculture is receiving a considerable attention because of their bioactivity and safety for human and the environment (El-Dissoky *et al.,*2013). Likewise, it has been found that the application of friendly solutes such as proline is being beneficial to stimulate plant nutrition and crop yield production under salt and other environmental stress, and it might be used to lessens the salt stress (Huang *et al.,* 2009). Also Proline is very important beneficial for pollen viability, germination, leaf water content and chlorophyll (Ashraf and Foolad, 2007). Furthermore humic acid was found to have a hormone-like activity which stimulates plant growth and development (Ferrara and Brunetti, 2010). Increasing cell membrane permeability, oxygen uptake, photosynthesis, phosphate uptake, and root cell elongation are some of the factors suggested to explain the positive effect of humic acid on plant growth (Aydin *et al.*, 2012). In this regard Turan *et al*. (2011) indicated that humic acid had positive impacts on dry weight and the N, P, K, Fe, Mn and Zn uptake of maize plants. Compost tea is another alternative techniques which prepared by steeping or brewing the compost in water using various preparation methods (Ingham, 2005). The compost tea as foliar application in salt-affected soils is very vital because its higher contents of different nutrients, i.e. (P, K, Mg, Ca, Fe, Ba, Mn and Zn), higher values of proteins, free amino acid and vitamins that might play an important role in improving growth and controlling the incidence of fungi diseases (Bevilacqua *et al.,* 2008).

The objective of this work was to study the influence of spraying different concentrations of proline, compost tea, yeast, humic acid and seaweed extract as bio stimulants on yield characters and grain chemical constituents of hybrid maize grown under saline soil conditions.

MATERIALS AND METHODS

A field experiment was conducted on maize at the Experimental Farm of the Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt, at Abees region during the growing season of 2017 to evaluate the role of some bio stimulants on yield characters of maize grown under salts affected soil. The soil salinity of the experimental site is classified as moderately salt affected soil. The physical and chemical properties are being listed in (Table 1) according to Jackson (1973). The plot area consisted of 5 ridges each 3.5 m in length and 3 m in width occupying an area of 10.5 m^2 (1/4000 fed) with the distance between hills 0.20 m. The maize seeds (*Zea mays*, L. cv. Hybrid 3062) were sown on 20/5/2017. Nitrogen fertilizer at the rate of 46 kg N /fed was added as urea (46 % N) in three equal doses after 15, 30, and 45 days after sowing. Phosphorus fertilizer, as calcium superphosphate (15.5 % P_2O_5) at the rate of 32 kg P_2O_5/fed and potassium sulphate (48.5 % K_2O) at the rate of 25 kg K_2O /fed were applied during seed ped preparation. Five different stimulatory growth sources with variable foliar application rates were used in complete randomized block design with three replications. The proposed treatments were; 1-proline (0, 0.1, 0.2,and 0.3 g/l), 2- compost tea (0, 5, 10,and 15 ml /l), 3-dry yeast (0, 20, 40,and 60 g /l), 4-Humic acid (0, 1, 2,and 3 g /l), and 5-Seaweed extracts (0, 1, 2,and 3 ml/l), each was sprayed three times during the growth period; first one was after 15 days of planting and then every 15 days for the second and third spray. Spraying was applied in early morning. The normal agronomic practices of growing maize were practiced till harvest. All plots were irrigated with adequate water to meet the crop needs at the various growth stages. At maturity, grain and straw yields were recorded. The biological yield was estimated as the sum of grain and straw yield components. The harvest index was estimated from the following formula,

Harvest index = (Grain yield / biological yield) x 100

To evaluate the effectiveness of the tested bio-stimulants and their application rates, the grains N, P, K, Na, as well as protein contents were assessed.

Table (1). Initial characteristics of the experimental soil

Soil property	Value
Particle size analysis	
Sand,%	31.12
Silt,%	16.00
Clay,%	52.88
Textural class	Clay
Organic matter,%	0.33
pH (1: 1 soil: water suspension)	8.20
EC_e , dS/m	6.29
$CaCO_3$,%	8.20
Soluble cations (meq/l)	
Ca^{++}	10.80
Mg^{++}	9.74
Na^{+}	38.23
K^{+}	1.4
Soluble Anions (meq/l)	
HCO_3^{-}	5.90
Cl^{-}	46.62
SO_4^{--}	8.71
SAR	11.95
Available N(mg/kg soil)	165.20
Available P(mg/kg soil)	13.47
Available K(mg/kg soil)	150.00

The growth bio-stimulants

1.Seaweed extract: The processed seaweeds used in the present study was obtained from Agro chemical company which prepared in Spain. The product contains cytokinis (1%), Auxins (1%) and other vegetal bio stimulants manitol, alginic acid and amino acids (glutamic acid, alanine, phenylalanine, glycine, proline, lysine, etc…).The nutrients composition of the sap is given in (Table 2). The analysis was carried by the laboratory of analysis at the Faculty of Science, Alexandria University using the method described by Rao (1990).

Table (2). The chemical composition of seaweed extract

Variables	Value
Nitrogen, mg/l	400.0
Phosphorous, mg/l	9.0
Potassium, mg/l	1520.0
Magnesium, mg/l	176.0
Iron, mg/l	2.4
Manganese, mg/l	0.4
Zinc, mg/l	3.2
Copper, mg/l	0.2
pH (1:2)	8.0
EC, dS/m (1:2)	2.4

2.Dry yeast: The Brewer's yeast *Saccharomyces sp.* sample was obtained from the Egyptian company of starch, and yeast in Alexandria. Proximate composition of the Brewer's yeast was presented by Sideney *et al.* (2017). Their results showed that proteins (49.63 %), carbohydrates (31.55 %), minerals (7.98 %), RNA (8.12 %) and total lipids (4.64 %) predominate in the biomass composition. The yeast contains some elements, such as Se, Cr, Ni, Mn, Zn, Cu, V, Cd, Pb, Fe, P, K, Mg and Ca. It is also contain low lipids with a predominance of saturated and mono-unsaturated fatty acids. Yeast solution was prepared according to method described by Morsi *et al.* (2008) and the yeast activation was done overnight by sucrose before treatment.

3.Humic acid: Humic acid was obtained from Agromatico Group Company for agriculture pesticides in 6 October city, Egypt. (Table 3) shows the chemical characteristics of humic acid.

Table (3). Some chemical composition of humic acid

EC dS/m (1:2)	**pH** (1:1)	**OM (%)**	**Macronutrients (%)**			**Micronutrients (mg/kg)**		
			N	**P**	**K**	**Zn**	**Fe**	**Mn**
0.8	7.5	70	5.0	0.5	4.0	250	400	240

4.Compost tea: Compost which used in this work was obtained from Egyptian Netherland Company for Organic fertilizers, Egypt. Compost tea was prepared with a 5% volume ratio (compost: distilled water) inside a glass or plastic container with agitation for 4 days as pointed out by Riggle (1996) to prepare aerated compost tea. (Table 4) shows the chemical characteristics of the compost and prepared compost tea. The compost tea was analyzed according to the standard methods for the examination of water and wastewater (APHA-AWWA-WEF, 2005). The compost was determined by the methods described by Page *et al.* (1982).

Table (4). Chemical composition of compost and compost tea

Compost		Compost tea(1:20)	
Property	**Value**	**Property**	**Value**
pH (1:2)	7.02	pH	7.10
EC (dS/m) (1:2)	4.10	EC (dS/m)	5.30
OM (%)	52.80	N (mg/l)	221.0
Total P (g/kg)	4.40	P (mg/l)	22.0
Total N (g/kg)	9.20	K (mg/l)	16.0
Ca^{2+} (g/kg)	1.17	Ca (mg/l)	14.0
Mg^{2+} (mg/kg)	627.20	Mg (mg/l)	7.0
Na^{+} (mg/kg)	416.00	Fe (mg/l)	133.0
K^{+} (mg/kg)	147.20	Mn (mg/l)	23.0
HCO^{-}_{3} (mg/kg)	652.80	Zn (mg/l)	14.5
$SO_4^{=}$ (mg/kg)	870.40	Cu (mg/l)	16.0

5.Proline: Proline ($C_5H_9NO_2$) is a protein genic amino acid that is used in the biosynthesis of proteins. It contains an α-amino group, an α-carboxylic acid group, and a side chain pyrrolidine, classifying it as a non polar aliphatic amino acid. L-Proline as chemical material was produced by LOBA CHEMIE chemical company in India.

Chemical analysis

Maize grains analysis:

Dried grain samples were milled and stored for analysis. Grain sample of 0.5 g of grain powder was wet digested with H_2SO_4–H_2O_2 mixture according to Lowther (1980) and the N, K, P and Na contents were determined according to the methods described by Jackson (1973). Also the Protein content was determined by multiplying the total nitrogen in the grains and by 6.25 according to AOAC (1990).

Soil analysis:

The collected soil samples at 80 days after sowing were prepared for analysis and the following determinations were carried out:

Available N: Soil samples were extracted by 2M KCl (1:20) and available N was determined in soil extract by Micro Kjeldhal according to the method described by Bermner and Mulvaney (1982).

Available P: Soil samples were extracted with 0.5 M $NaHCO_3$ solution adjusted to pH 8.5 according to the method described by Olsen *et al.* (1954) and the P was measured using ascorbic acid molybdenum blue method (Jackson,1973).

Available K and extractable Na: Soil samples were extracted by ammonium acetate (1 N of pH 7.0) and K and Na was determined according to Jackson (1973) by Jenway PFP -7 flame photometer.

Statistical analysis

All the data collected were subjected to statistical analysis of variance as described by Gomez and Gomez (1984). The treatment means were compared using LSD test at 0.05 level of significant.

RESULTS AND DISCUSSION

A) Effect of the bio stimulants treatments on yield characters

The data of grain yield data as influenced by the different bio-stimulants concentrations are presented in (Table 5). The results showed that potential grain yield performance varied considerably between the stimulating agents and even between the application rates ranging from 3.50 to 5.59 t/fed. The highest yield potential was clearly detected with foliar application of compost tea at 15 ml/l (5.59 t/fed), followed by foliar application of humic acid at 3 g/l (5.32 t/fed) and also, compost tea at 10 ml/l (5.14 t/fed), respectively. The minimum grain yields were obtained with control treatments. Also, at the different levels effect of the applied bio stimulants, maize straw yield imposed variable records (Table 5). The obtained data showed that the maximum weight of straw yield was associated with foliar application of proline at 0.3 g/l (7.93 t/fed), followed by foliar application of humic acid at 3 g/l (7.93 t/fed), and compost tea at 15 ml/l (7.78 t/fed), respectively. Also, the minimum straw yields were recorded at the control treatments. In the same (Table 5) the data showed that the maximum biological yield (t/fed) was found with foliar application of humic acid at 3 g/l (13.03 t/fed), followed by foliar application of compost tea at 15 ml/l (12.85 t/fed) and foliar application of yeast at 60 g/l (12.35 t/fed), respectively, while, the control treatment gave the lowest mean values of biological yield.

The term “harvest index” is used to quantify the yield performance with respect to the total amount of biomass. For grain crops, harvest index is the ratio of harvested grain to total shoot dry matter, and this can be used as a measure of reproductive efficiency. Data recorded in (Table 5) showed that the maximum harvest index percentage of maize was positively associated with foliar application of compost tea at 15 ml/l (43.49 %), followed by foliar application of compost tea at 10 ml/l (43.48 %), foliar application of compost tea at 5 ml/l (43.34 %) and proline at 0.3 g/l (41.49 %), respectively, while, the control treatments gave the lowest mean values of harvest index percentage. All of the previous results are in agreement with those obtained by Khan *et al.* (2015), El-Shafey and Zen El-Dein (2016) and Ibrahim (2016).

B) Effect of the bio stimulants treatments on chemical constituents of maize grains under salinity conditions

The contents of N, P, K, and Na in maize grains

The data presented in (Table 6) showed that the highest mean values of N, P and K contents in grains were observed at the high rates in the foliar application of compost tea at 15 ml/l (18.23, 7.94, and 3.0 g/kg), followed by foliar application of humic acid at 3 g/l (17.10, 7.41, and 2.8 g/kg) and proline at 0.3 g/l (16.26, 7.16, and 2.6 g /kg), yeast at 60 g/l concentration (15.06, 6.96, and 2.2 g/kg) and seaweed at 3 ml/l concentration (13.76, 6.67, and 1.9 g/kg) respectively. The minimum values were observed in control treatments.

Similarly, the lowest mean values of sodium content in grains was observed in the treatment of foliar application of proline at 0.3 g/l (1.0 g/kg), followed by foliar application of compost tea at concentration of 15 ml/l (1.1 g/kg), humic acid at 3 g/l concentration (1.1 g/kg), yeast at 60 g/l concentration (1.2 g/kg), and seaweed at 3 ml/l concentration (1.2 g/kg), respectively.

Table (5). Effect of different bio stimulants treatments on grain yield, straw yield, biological yield, and harvest index of maize

Bio stimulants Treatments	Grain yield (t/fed)	Biological yield (t/fed)	Straw yield (t/fed)	Harvest index (%)
Proline, 0 g/l	3.64	9.54	6.17	38.15
Proline, 0.1g/l	4.17	10.38	6.71	40.17
Proline, 0.2 g/l	4.53	11.28	7.29	40.18
Proline, 0.3 g/l	4.94	12.20	7.93	41.49
Compost tea, 0 ml/l	4.34	10.85	6.09	40.00
Compost tea, 5 ml/l	4.72	10.89	6.61	43.34
Compost tea, 10 ml/l	5.14	11.82	7.17	43.48
Compost tea, 15 ml/l	5.59	12.85	7.78	43.49
Humic acid, 0 g/l	4.14	10.14	6.16	40.82
Humic acid, 1 g/l	4.50	11.02	6.72	40.89
Humic acid, 2 g/l	4.90	11.98	7.28	40.90
Humic acid, 3 g/l	5.32	13.03	7.93	40.82
Yeast, 0 g/l	3.68	9.54	5.65	38.57
Yeast, 20 g/l	4.00	10.45	6.19	38.28
Yeast, 40 g/l	4.35	11.36	6.67	38.29
Yeast, 60 g/l	4.73	12.35	7.26	38.30
Seaweed, 0 ml/l	3.50	10.01	5.81	34.96
Seaweed, 1 ml/l	3.81	10.88	6.34	35.01
Seaweed, 2 ml/l	4.14	11.82	6.88	35.03
Seaweed, 3 ml/l	4.50	12.33	7.57	36.50
LSD (0.05)	**0.05**	**0.30**	**0.16**	**0.93**

The maximum Na contents values were observed in control treatments. It is clear from the data that proline is more effective in decreasing sodium content in maize grain. However all the bio stimulants have positive effects in decreasing the Na contents in maize grains. Similar type of observations of increased nutrient (N, P and K) concentration was observed by Mancuso *et al.* (2006), Rathore *et al.* (2009) and Abd-El Motty *et al.* (2010) in grapevines and cucumber, soybean and mango, respectively, due to the application of seaweed extract.

Sodium is the principal toxic ion for maize (Sümer *et al*., 2004) which interfere with potassium uptake leading to disturbance in stomatal modulations and necrosis. Competition between potassium and sodium under salt stress severely reduces potassium content in leaves and roots of maize (Kaya *et al*., 2010 and Shahzad *et al*., 2012). The high values for sodium / potassium ratios in the grains of maize at the lower concentrations of the bio stimulants (control) as shown in (Table 6) confirm that impaired transport of potassium, by sodium might upset plant metabolism leading to reduced growth under saline conditions. Similar observations was observed by Shahzad *et al*. (2012).

Protein content in grains

From the data presented in (Table 6) it is clear that the protein content was significantly affected by various treatments. The maximum protein content in grains was observed in the treatment of foliar application of compost tea at 15 ml/l (11.39 %), followed by foliar application of humic acid at 3 g/l (10.68 %), compost tea at 10 ml/l (10.45 %), proline at 0.3 g/l (10.19 %), yeast at 40 g/l (9.41 %), seaweed at 3 ml/l (8.60 %), respectively. The lowest protein contents were recorded in control treatments. These results were in agreement with those obtained by Daur and Bakhashwain (2013), Ibrahim (2016) and Saddon *et al.* (2016).

Table (6). Effect of the bio-stimulants treatments on N, P, K, Na and protein contents of maize grains

Bio stimulants treatments	N g/kg	P g/kg	K g/kg	Na g/kg	Na/K ratio	Protein %
Proline, 0 g/l	12.63	5.57	2.02	1.40	0.69	7.89
Proline, 0.1g/l	13.40	6.06	2.20	1.27	0.57	8.38
Proline, 0.2 g/l	14.96	6.58	2.39	1.15	0.48	9.31
Proline, 0.3 g/l	16.26	7.16	2.60	1.05	0.40	10.19
Compost tea, 0 ml/l	14.20	6.17	2.33	1.55	0.66	8.87
Compost tea, 5 ml/l	15.43	6.72	2.54	1.43	0.56	9.63
Compost tea, 10 ml/l	16.73	7.30	2.76	1.30	0.47	10.45
Compost tea, 15 ml/l	18.23	7.94	3.00	1.18	0.39	11.39
Humic acid, 0 g/l	13.30	5.77	2.21	1.57	0.71	8.31
Humic acid, 1 g/l	14.46	6.27	2.41	1.43	0.59	9.04
Humic acid, 2 g/l	15.70	6.82	2.55	1.30	0.51	9.81
Humic acid, 3 g/l	17.10	7.41	2.84	1.16	0.41	10.68
Yeast, 0 g/l	11.70	5.41	1.80	1.62	0.90	7.31
Yeast, 20 g/l	12.70	5.89	1.95	1.47	0.75	7.94
Yeast, 40 g/l	13.86	6.40	2.09	1.34	0.64	8.66
Yeast, 60 g/l	15.06	6.96	2.29	1.22	0.53	9.41
Seaweed, 0 ml/l	10.80	5.19	1.49	1.69	1.13	6.75
Seaweed, 1 ml/l	11.60	5.64	1.62	1.53	0.93	7.25
Seaweed, 2 ml/l	12.66	6.14	1.76	1.40	0.80	7.91
Seaweed, 3 ml/l	13.76	6.67	1.92	1.27	0.66	8.60
LSD (0.05)	**0.37**	**0.06**	**0.07**	**0.03**		**0.23**

The application of the bio stimulants resulted in significant increase in protein concentration; was due to by either increasing protein biosynthesis or decreasing its oxidation (Singh and Chandel, 2005), reported that protein content in wheat grain was greatly influenced by application of seaweed extract, due to its promotive effects on root proliferation, thus higher acting for enhancing nutrients uptake particularly those needed as constituents in protein synthesis (nitrogen, phosphorus and sulphur) resulting in higher protein synthesis.

C) Effect of the bio-stimulants treatments on N, P, K and Na Status of soil

The available N, P, K and Na status of soil did not show any marked difference due to the different bio stimulants foliar application of variable concentrations (Table 7). Among the treatments numerically higher available N and P content was recorded in compost tea at the higher concentration. The higher available K was observed at the higher concentration of humic acid. The data regarding effect on available sodium in soil revealed also, that no remarkable variations due to the different bio stimulants foliar application at varied concentrations (Table 7). However lower values of Na content was observed using proline and seaweed at the higher concentrations. On the other hand, higher values of Na content were observed using compost tea, humic acid and yeast at the higher concentrations. The no significantly effects can be reasoned that the spray solution application of the bio-stimulants can not account for the significant changes in the soil.

Table (7). Effect of the bio-stimulants treatments on available N, P, K and Na in soil at 80 days after sowing

Bio-stimulants treatments	N mg/kg	P mg/kg	K mg/kg	Na g/kg
Proline, 0 g/l	271.23	23.33	650.11	2.18
Proline, 0.1g/l	270.71	23.35	550.16	2.07
Proline, 0.2 g/l	276.60	23.35	620.12	2.12
Proline, 0.3 g/l	278.12	23.34	580.06	2.11
Compost tea, 0 ml/l	267.52	23.36	600.12	2.12
Compost tea, 5 ml/l	275.24	23.37	670.27	1.98
Compost tea, 10 ml/l	275.61	23.38	630.41	2.10
Compost tea, 15 ml/l	280.11	23.35	570.23	2.28
Humic acid, 0 g/l	262.64	23.38	580.14	2.32
Humic acid, 1 g/l	272.10	23.39	620.42	2.57
Humic acid, 2 g/l	276.80	23.38	750.36	2.72
Humic acid, 3 g/l	274.92	23.40	810.40	2.38
Yeast, 0 g/l	271.71	23.37	650.18	2.28
Yeast, 20 g/l	278.80	23.38	630.01	2.20
Yeast, 40 g/l	293.25	23.39	670.22	2.63
Yeast, 60 g/l	300.11	23.38	620.13	2.73
Seaweed, 0 ml/l	283.23	23.40	630.04	2.35
Seaweed, 1 ml/l	283.53	23.42	620.25	2.62
Seaweed, 2 ml/l	279.80	23.45	620.42	2.20
Seaweed, 3 ml/l	285.31	23.45	620.36	2.08
LSD (0.05)	**7.54**	**0.14**	**146.01**	**0.52**

The study illustrated that all the tested bio stimulants were able to improve salinity stress tolerance of maize plants especially the compost tea followed by the other bio-stimulants. The superiority of plant growth and yield characters in response to the foliar application of compost tea may be attributed to its contents of different nutrients, i.e. (N, P, K, Mg, Ca, Fe, Mn Cu and Zn), higher content in proteins free amino acid and vitamins which may play an important role in improving growth and controlling the incidence of fungi diseases as stated by Bevilacqua *et al*. (2008). The most effect treatment observed when compost tea applied at a 15 ml/l concentration. Also, the positive effect of humic acid on yield characters may be caused by its content of N, P, K, Zn, Fe and Mn which causes an enhancement in the synthesis of the chlorophyll and/or delayed chlorophyll degradation in the different leaves, primary and lateral shoot leaves. It seems that foliar application of humic acid as a bio-stimulant can facilitate respiration and photosynthesis processes via modified functioning of mitochondria and chloroplasts (Nardi, 2002). The positive effect of Proline on yield characters of maize plants is considered as an osmoprotection agent and known to be involved in reducing the oxidative damage by scavenging the free radicals. Ashraf and Foolad (2007) reported that foliar application of proline is a shotgun strategy to alleviate salt stress and enhances the crop growth and its yield through decreasing in Na and Cl accumulation. Regarding the yeast as bio stimulants, the enhancement may be attributed to its contents of proteins, carbohydrates, minerals, RNA and lipids predominate in the biomass composition. It was also observed that the yeast contain some elements, such as Se, Cr, Ni, Mn, Zn, Cu, V, Cd, Pb, Fe and some macro elements such as P, K, Mg and Ca. Also, the enhancement effect of seaweeds on yield may be due to increasing plant chlorophyll content which might be caused in part by betaines in the seaweed extract (Whapham *et al.,* 1993) and improving plant mineral content in leaves (Mancuso *et al.,*2006) as shown in (Table 2) of this work. Also, the existence of cytokinins, auxins, gibberellins, betaines, macronutrients (Ca, K, P) and micronutrients (Fe, Cu, Zn, B, Mn, Co, and Mo) in their components, necessary for the development and growth of plants (Khan *et al*., 2009).

Even though these bio-stimulants are increasingly used for crop production, the influence of these products on the crop plants production in relation to soil health is largely unknown. Hence, there is a need for testing the use of these bio stimulants through large scale field trials and organizing public awareness programs. Intensified study is needed on application of these materials either to soil or foliar continuously over a long period to study its effect with the suitable concentration and practices on crop productivity and soil health under soil stress conditions.

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الملخص العربي

دور بعض المنشطات الحيويةعلى المحصول والمحتوى الكيميائي لحبوب الذرة النامي تحت ظروف الأرض المتأثرة بالأملاح

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**طالب دراسات عليا

أجريت تجربة حقلية على الذرة الشامية في المزرعة التجريبية لكلية الزراعة (سابا باشا)، جامعة الإسكندرية، مصر ، خلال موسم النمو لعام ٢٠١٧ لتقييم دور بعض المنشطات الحيوية في إنتاجية الذرة النامية في ظل التربة المتأثرة بالأملاح، وتم تصميم التجربة في قطاعات عشوائية كاملة مع ثلاث مكررات، كل مكررة تحتوي على٢٠ معاملة على النحو التالي: مستخلص الأعشاب البحرية في معدلات (٠، ١، ٢، 3 مل/ لتر)، وحامض البرولين في معدلات (٠ ، ٠.١ ، ٠.٢ ، ٠.٣ جم/ لتر) ، والخميرة الجافة النشطة في معدلات (٠ ، ٢٠ ، ٤٠ ، ٦٠ جم/لتر)، وحمض الهيوميك بمعدلات (٠، ١، ٢، ٣ جم/لتر) وشاي الكمبوست بمعدلات (٠ ، ٥ ، ١٠ ، ١٥ مل/ لتر) وتشير النتائج إلى أن الرش بسماد شاي الكمبوست بتركيز ١٥ مل/ لتر أعطى أعلى متوسط قيم لمحصول الحبوب (٥.٥٩ طن/فدان)، ودليل الحصاد، والمغذيات لكل من النيتروجين والفوسفور والبوتاسيوم ومحتوى البروتين في الحبوب، في حين سجلت المعاملة بحمض الهيوميك بتركيز ٣ جم/لتر أفضل النتائج من المحصول البيولوجي (١٣.٠٣ طن/فدان)، ومحصول القش (٧.٩٣ طن/فدان)، في الوقت نفسه، أنخفض تركيز الصوديوم في الحبوب مع زيادة تركيز كل من المنشطات الحيوية الأخرى ، وأعطى البرولين عند التركيز الأعلى المحتوى الأدنى من الصوديوم في الحبوب ، بينما لم تظهر حالة النتروجين، والفوسفور، والبوتاسيوم ، والصوديوم المتاح في التربة أي فروق كبيرة عند إضافة المعاملات بالرش الورقي .