INFLUENCE OF COMPOST TEA, *AZOLLA* AND YEAST ON GROWTH OF WHEAT IN SALINE SOIL

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Abstract

Two field experiments were carried out to study the effect of compost tea, Azolla and yeast alone or mixed with different rates from urea fertilizers on soil properties and wheat productivity under saline soil condition in Sahl El Hossinia, El – Sharkia Governorate during two winter seasons of 2008 – 2009 and 2009 -2010. Urea rates (50 and 75 Kg N Fed^{-1}) . The results indicated that increasing mineral nitrogen dose of application from 50 to 75 Kg N Fed^{-1} with compost tea led to increase the counts of total bacteria and cyanobacteria. Therefore increase, the rate of respiration and subsequently increased the amounts of evaluated CO_2 and also increased both dehydrogenase and nitrogenase activities. In all treatments decreased soil pH and EC as a result of improving soil physical properties and activity microorganisms compared with control treatments. The highest organic matters were obtained with application of T_{11}, T_{12}, T_9, T_{10} and T_3. Data showed that nitrogen, phosphorus and potassium soil content were significantly increased when application with T_{11} over all treatments. The highest NPK contents were 114.50, 6.18 and 245 ppm respectively. Application of treatment T_{12} (50 Kg N + *Azolla* + yeast + compost tea) non – significant increase in plant height with T_7 (75 Kg N + compost tea) and T_9 (75Kg N + *Azolla* + yeast) giving 97.3, 96.60 and 99.64 cm $plant^{-1}$. The treatment of compost tea addition with different levels of urea (75 and 50 Kg N. Fed^{-1}) increased the plant high, grain yield and the weight of 1000 grains and also increased plant dry weight and straw yield compared the control (T_1 and T_2). However, $T_{12\ treatment}$ (50 Kg N + *Azolla* + yeast + compost tea) (485.82 /m $^{-2}$ grain) giving highest recorded for all treatments accept T_{11} (75 Kg N + *Azolla* + yeast + compost tea) giving 499.78g / $m_{2.}$ The highest value T_{11} (1000 grain weight) was significantly higher than all tested treatments. Both of T_9 and T_{12} of these high values were significantly higher than the control treatment. Higher value of P and K concentrations for wheat grain and straw were achieved with the application T_{11} and T_9 treatments than the other treatments. The recorded values of N, P and K concentration by grains were 1.85, 0.78 and 1.82 % for soil treated with compost tea combination (75 Kg N Fed $^{-1}$).

Key words: Compost tea, *Azolla*, yeast, microorganisms, soil salinity, wheat production.

Introduction

Salinity and soil nutrient deficiencies are the main factors reducing plant productivity in arid and semi – arid areas. Among the essential elements, nitrogen is usually the most growth limiting plant nutrient in saline or non – saline soils.

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The compost can be a very good organic amendment in saline agriculture as well as, for reclamation of salt – affected soils **(Zaka, *et al*., 2003).** Compost tea is emerging as a crop protection tool for organic agriculture for a number of reasons, It contains microorganisms which can reduce incidence of foliar and / or soil borne diseases, and nutrients contented in compost tea which support the survival and proliferation of microorganisms. It contains nutrients (extracted from compost) in a readily available form (**Al – Kahal, *et al*., 2009**). Organic fertilizers in comparison of the chemical fertilizers have lower nutrient content and are slow release but they are as effective as chemical fertilizers over longer periods of use (**Naguib, 2011**). Organic manures can serve as alternative to mineral fertilizers for improving soil structure (**Dauda *et al*., 2008**) and microbial biomass (**Suresh *et al*., 2004**). These are also used to provide biological control against various plant pathogens (**Hoitink and Grebus, 1994**).

Active dry yeast is a natural safety biofertilizers causes various promotive effects on plants. It is considered as a natural source of cytokinins which simulates cell division and enlargement as well as the synthesis of protein, nucleic acid and B– vitamin. (**Amer**, **2004**). It also releases CO_2 which reflected in improving net photosynthesis (**Kurtzman**, **2005**).

Dry yeast and compost tea were used in growing medium of Borago plants. The results revealed that 20 L./ fed. of compost tea significantly increased plant height, fresh and dry weight of aerial parts and flowers and number of branches and suckers, adding dry yeast at the rate of 6 g / L was the most effective on growth parameters and oil % (**Ezz El – Din and Hendawy, 2010**).

Reda *et al.*, 2011 reported that *Azolla* growth rate is very high (3 – 5 days) under optimal conditions. *Azolla* not only increase rice yield but also improve soil fertility. They found that use of different bio – fertilizers including *Azolla*, along with a low input of chemical – N fertilizer is useful for increasing rice yield. **Norton (2004)** suggested that, use of *Azolla* species in rice fields will keep the floodwater pH low and hence this led to fewer losses of applied fertilizers, and the growth of *Azolla* is benefit if the soil has a high available P content and low P sorption capacity. *Azolla* incorporated to soil, improves soil structure, increasing organic matter, total fixed nitrogen, phosphorus and other nutrients into soil. **Awodun** (**2008**) studied potentiality of *Azolla* to improve soil physical properties such as bulk density and porosity. In addition, they reported its ability to improve soil chemical properties (organic matter, N, P, K, Ca, Mg and Na).

Biofertilizers are microbial inoculants consisting of living cells of microorganisms like bacteria, algae and fungi alone or combination which may help in increasing crop productivity. Biological activities are markedly enhanced by microbial interactions in the rhizosphere of plants (**Tilak and Reddy, 2006**). Application of organic and biofertilizers as substitute for inorganic fertilizers in order to grow the medicinal and aromatic plants, should not be considered as a simple objective and short term benefits, but as a mean to improve environmental conditions and human health. (**Shahram and Kourosh, 2011**).

The aim of the current study is to evaluate the effect of compost tea, *Azolla*, yeast and urea nitrogen on wheat yield and yield components. Growing in saline soil as well as soil biological activity, total bacteria and cyanobacterial count, Co_2 evoluation, dehydrogenase and nitrogenase activity under saline soil condition.

Material and Methods

Two field experiments were carried out at a farm located at sahl El. Hossinia, El. Sharkia Governorate during two successive winter seasons of 2008 – 2009 and 2009 – 2010 to study the role of compost tea, *Azolla* and combined with different rate of mineral nitrogen (urea 46.5 %) 50 and 75 Kg N Fed^{-1} on saline soil, biological activity, soil properties and wheat productivity.

Soil analysis

The experiment filed soil was sampled initially before and after wheat grown conducting the experiment to determine its physical and chemical analyses according to **Jackson** (**1976**). The results of these analyses are shown in Table (1).

Preparation of compost tea

An aerated compost tea (ACT) from composted corn stalks, rice straw and plant resudwal. Mature compost was suspended in a barrel of water for 7 days to produce compost extract. A 50 L tank is fitted with air bubblers that are attached to an aquarium type aeration pump (**Ingham, 2005**). The tank was half filled with water and air was passed through it for approximately 10 – 20 minutes from the air bubbles. Compost extract is the added to fill the tank. The aerator provides continuous flow of air. An aerated compost tea was aerobically brewed for 15 days but it can be brewed for longer if desired. Soluble macro and micro – nutrients of used compost tea. EC 1.01, pH 6.33, Available nitrogen 200 ppm, P 10 ppm, K 211 ppm, Ca 69 ppm, Mg 106 ppm, Fe 59 ppm and Z 17 ppm.

***Azolla* extract and yeast**

Azolla pinnata, yeast and compost tea were kindly obtained from Agric. Microbiology, Res. Dept., soils & water and Environment . Res. Inst. (SWERI)., Agric., Center (ARC). Giza Egypt. Wet *Azolla* were hardly crushed mixed with water (1 : 1 w/ v) and blended to obtain homogenous suspension. The obtained suspension was filtrated through cotton cloth. The obtained filtrated represents *Azolla* extract to be used as foliar spray.

Active dry yeast (6g L^{-1})were dissolved in water flowed by adding sugar at ratio 1 : 1 and kept for activation and reproduction of yeast before application on the plant.

Table (1) : Physical and chemical characteristics of the experimental soil.

Physical analysis	Course sand%	10.79
	Fin e sand %	22.15
	Silt %	9.5
	Clay %	47.56
	Texture	Clay loam
Chemical analysis	PH (1 : 2.5)	8.17
	EC (ds/m)	14.15
	O.M%	0.67
	Ca Co_3 %	7.15
Cations (mg^{-1})	Ca^{++}	15.49
	Mg^{++}	18.71
	Na^{+}	192
	K^{+}	1.52
Anion (mg^{-1})	So_4^{-}	31.1
	CL^{-}	188
	HCo_3	8.62
Available nutrient mg Kg^{-1} soil	Cu	0.05
	Zn	0.69
	Mn	3.51
	Fe	1.69
	N	59.19
	P	4.9
	K	168

Field experiment:

Two field experiments were carried out on salt affected soil (EC 14.15 dS / m^{-1}) at Sahl El-hossinia, during two winter seasons 2008 – 2009 and 2009 – 2010 to evaluate the application of compost tea, *Azolla* and yeast in the presence of urea (75 and 50 Kg N Fed^{-1}) on growth and yield of wheat plant seeds (sakha 69) . Wheat seeds kindly obtained from Crop Res. Inst., Agric. Res. Center, Giza, Egypt.

All treatments under investigation were arranged in a complete randomized blook design according to **Gomez and Gomez** (**1984**) with three replicates. Wheat plants were exposed to foliar spraying by compost tea, *Azolla* extract and yeast extract. Urea was applied in two doses (75 and 50 Kg N Fed^{-1} at 15 and 45 days after sowing), at the doses of 75 and 50 Kg N fed $^{-1}$ individually or in combination with tested treatments. The field was divided into 12 plots with three replicats in the following :

T_1 = 75 Kg N – urea.
T_2 = 50 Kg N – urea.
T_3 = 75 Kg N – urea + *Azolla* (5 L/m $^{-2}$) Foliar
T_4 = 50 Kg N – urea + *Azolla* (5 L/ m^{-2}) Foliar
T_5 = 75 Kg N – urea + Yeast (2 Kg dry yeast Fed $^{-1}$)
T_6 = 50 Kg N – urea + Yeast (2 Kg dry yeast Fed $^{-1}$)
T_7 = 75 Kg N – urea + compost tea (20 L / Fed^{-1})
T_8 = 50 Kb N – urea + Compost tea (20 L / Fed $^{-1}$)
T_9 = 75 Kg N – urea + *Azolla* + Yeast .
T_{10} = 50 Kg N – urea + *Azolla* + Yeast .
T_{11} = 75 Kg N – urea + *Azolla* + Yeast + compost tea .
T_{12} = 50 Kg N – urea + *Azolla* + Yeast + compost tea .

The experimental unit (plot area) was 3.5 x 4 m ^{2}. The amount of the compost tea, *Azolla* yeast and all treatments were drivided into three portions (21 – 45 – 65 days of sowing plants). Compost tea added at the rate of 20 L / Fed^{-1} according to **Hendawy *et al*. (2010)**., *Azolla* 5 L / m_2 and yeast extract (2kg Fed^{-1}).

In control, the recommended doses of nitrogen (Urea 46.5 % N) 75 and 50 Kg N Fed $^{-1}$, phosphorus (Calcium super phosphate (15.5 % $P_2 O_5$), 150 Kg Fed $^{-1}$ and K (Potassium sulphate 48 % K_2SO_4) 48 Kg Fed^{-1} fertilizer . Wheat seeds varity (Sakha 69) was supplied by filed Crop Res. Five seeds were sown in every holl with 5 cm depth. After 18 day of planting, the plant of each hole was thinned to one plant. At harvesting stage, surface soil sample were collected, air dried ground good mixed.

Methods Analysis:

The collected soil samples before drying were used for determination of soil biological activity, soil total bacterial count (**Vincent, 1970**), cyanobacteria count (**Allen and Staniar 1968**), carbon dioxide evolution (**Gaur *et al*., 1971**), dehydrogenase (DHA) (**Casida *et al*., 1964**) and nitrogenase activity (**Hardy *et al*., 1973**) Soil organic matter was determined according to the methods described by **Black (1965)** , pH was measured using pH meter in soil (1 : 2.5) and electrical conductivity (EC) were measured in soil pest according to (**Jackson, 1976**) . On the before harvesting three plants of each treatment were collected and ovened dried at 70 C and weighed. The oven dried grain and straw were ground 0.5 g of each sample was suggested according to (**Chapman and pratt, 1961**). The grain and straw contents of NPK was determined according to **Black, (1965)**.

Results and Discussion

In this study will provide information for better source of organic and bio fertilizers to increase the organic fertilizer input and improve the saline soil, plant nutrient, soil biological activity, wheat production and soil properties in saline soil. Two field experiments were carried out during the two seasons.(data mean values of two seasons).

Population density of soil microorganisms:

Data in Table (2) showed the effect of compost tea, *Azolla* and yeast and when applied alone or mixed together on densities of soil microbes in experimental saline soil after wheat harvesting. Nitrogenase activity in wheat rhizosphere zone of root in µ mole C_2H_4 /g dry soil/hr. and dehydrogenase in µg TPF/g dry soil /day after harvisted wheat are presented in Table (2).

Data in Table (2) indicate that the soil biological activity after wheat harvesting in terms of cyanobacteria count, total bacteria count, Co_2 evolution as well as dehydrogenase (DHA) and nitrogenase activities as affected with *Azolla*, yeast, compost tea and/or nitrogen fertilizer either alone or combined together. All tested soil biological activity parameters under the effect of tested treatments with higher than those of the control treatments. The numbers of total cyanobacteria and bacteria show a positive increasing response to treatments T_{11} and T_{12} treatments. On the other hand, increasing the nitrogen levels from 50 Kg N (T_{12}) up to 75 Kg N (T_{11}) increasing the total cyanobacteria and the total bacteria counts compared to those control T_1 and T_2 treatments by 75 and 50 Kg N Fed^{-1}. The highest cyanobacteria and bacteria counts were recorded in response to T_{11} (*Azolla*, yeast, compost tea and 75 Kg N Fed^{-1}) inoculation giving 156.36 x 10^3 and 265.75 x 10^5 CFU respectively. Inoculation with 2/3 recommended dose of nitrogen based treatment (T_{12}) (*Azolla*, yeast, compost tea) inoculation in wheat cultivation significantly increased compared to T_2 treatment. The treatments received nitrogen only were less in total cyanobacteria and total bacteria count than those received *Azolla* , yeast, compost tea inoculation. These results are on the line with **Rao & Burns (1990)** previously vitamins and plant growth stimulation hormone. In addition, cyanobacteria excrete polysaccharides thereby improving soil aggregation, as well as stimulate some beneficial soil microorganisms**. Mandel *et al*. (1999)** reported a significant increase in organic carbon content in the soil due to successive *Azolla* cropping with rice plant, which in turn increased soil fertility through enhancing the growth and biomass of the soil microorganisms. The highest values during the two seasons were in Table (2).

Table (2): Effect of compost tea , *Azolla* and yeast on soil biological activity after wheat harvesting (data mean values of two seasons)

Treatments	Cyanobacteria count CFU.g.d.wt soil X 10^3	Total count bacteria CFU g.d.wt soil X 10^5	Co_2 evolution mg CO_2 100 g $soil^{-1}$	Dehydrogenase activity Ug TPF 100g soil. Day	Nitrogenase activity U Mol C_2H_4 g dry wet soil /hr
T_0	8.53	31.20	75.00	21.00	35.00
T_1	11.80	35.20	102.0	26.80	43.29
T_2	9.60	32.90	98.20	24.50	35.80
T_3	65.80	96.81	121.80	53.20	57.83
T_4	54.30	59.40	101.45	47.13	47.35
T_5	26.35	60.90	111.55	66.11	39.40
T_6	25.40	54.20	105.75	55.15	30.20
T_7	66.75	105.86	155.20	89.90	60.60
T_8	59.18	69.41	121.00	60.40	59.18
T_9	96.30	118.00	212.45	90.95	63.36
T_{10}	80.55	86.40	140.62	81.15	60.14
T_{11}	156.36	265.75	254.43	98.80	96.15
T_{12}	115.25	201.96	190.56	89.15	69.40

Data in table (2) indicated that the treatments of T_{11} , T_9 , T_{12} and T_{10} increased the Co_2 evaluated, dehydrogenase and nitrogenase activities being 254.43 , 212.45, 190.56 , 140.62 mg Co_2. 100 g^{-1} soil , 98.80 , 90.95 , 89.15 and 81.15 ug .TPF. $100g^{-1}$ soil and 96.15 , 63.36 , 69.40 and 60.14 µ mole C_2H_4 g^{-1} soil respectively. The same trend was reported by **Abd El-Rasoul, *et al*.,(2004)** who reported that inoculation with cyanobacteria increased the soil microbial biomass, which in turn increase $C0_2$ and the DHA as a results of the massive respiration process.

Generally total cyanobacteria and bacteria counts, Co_2 evaluation, dehydrogenase and nitrogenase activity were increased by the addition of compost tea with different level of urea (75 and 50 Kg N. Fed^{-1}). Increasing mineral nitrogen dose of application from 50 to 75 Kg N. Fed^{-1} with compost tea led to increase the counts of total bacteria and cyanobacteria, therefore increase the rate of respiration and subsequently increased the amounts of evolved Co_2 and also increased both dehydrogenase and nitrogenase activities. On the other hand, result simarlly with (**El – Zeky *et al* ., 2005**) .

It could be concluded that the inoculation of wheat with *Azolla*, yeast, compost tea are of importance in the view of being used as biofertilizers as well as protecting the environment from pollution and consequently producing a satisfactorynd good wheat yield. **Kheder and Farid** (**2000**) demonstrated that the effect of yeast is due to its capability in induction of endogenous hormones like GA_3 and IAA. Recently dry yeast is used as an alternative source of growth substances in bioorganic fertilization system.

Yield and yield components:

Soil chemical properties and fertility conditions are reflected on plant growth, which in turn affect the yield and yield components shown in Table (3) . There was significant increase in plant height with T_9 and T_{11} treatments in both seasons as compared to all the other treatments. High records of plant height being 99.64 and 108.5 cm plant^{-1} resulted in treatments T_9 and T_{11}respectively.

However, the use of application *Azolla*, yeast, compost tea alone or in combination mixture showed increase in plant height as compared to the control treatment T_1. Application of treatment T_{12} (50 Kg N + *Azolla*+ yeast+ compost tea) non-significant increase in plant height with T_7 (75 Kg N + Compost tea) and T_9 (75 Kg N + *Azolla*+ yeast) giving 97.3, 96.60 and 99.64 cm plant^{-1} .

Plant dry weight:

Data in Table (3) indicated that all the treatments gave higher dry weight than the control T_1 (75 Kg N) and T_2 (50 Kg N). The highest records were obtained with T_{11} , T_9 and T_7 treatments giving 2.14 , 1.94 and 1.92 Kg m^1 respectively. On the other hand, treatment T_{12} (50 Kg N + *Azolla*+ yeast+ compost tea) was non-significant with treatment T_7 (75 Kg N + Compost tea) giving 1.92 Kg m^{-1}. Application of treatment T_{10} (50 Kg N + *Azolla*+ yeast) giving the highest plant dry weight 1.78 Kg m^{-1} compared to T_3 (75 Kg N + *Azolla*) giving 1.68 Kg m^{-1} .

Grain & Straw yield and 1000 grain weight:

Data in table (3) indicated the thickness increase in grains and straw yield were determined with treatments T_{11} and T_{12} for grain and T_4 and T_7 for straw yields. In addition all tested treatments significantly increased for grain yield over control, but non significantly increased of straw yield over control. Application of T_{11} and T_{12} treatments showed highest grain yields (499.78 and 485.82 g/m^2) as compared with T_1, T_2 treatments (305.15 and 290.45g / m^2). However, T_{12} treatment (50 Kg N +*Azolla* + Yeast + Compost tea) (485.82/m^2 grain) giving highest recorded for all treatments accept T_{11} (75 Kg N + *Azolla*+ yeast+ compost tea) giving 499.78 g / m^2. **El – Howeity *et al*.** (**2004**) found that inoculation of wheat with diazotrophs bacteria under different levels of nitrogen fertilizer significantly increased shoot, root, dry weights and yield compared to control. Inoculation with T_4 treatment (50 Kg N + *Azolla*) and T_7 treatment (75 Kg N+

compost tea) giving the highest recorded straw yield (1.02 Kg/m^2) non significantly with all tested treatment.

Table (3): Yield and yield components of wheat cultivated in two seasons affected by compost tea, *Azolla*, yeast and nitrogen sources under saline soil conditions (data are a mean two seasons)

Treatments	**Plant high (cm)**	**Plant dry weight (kg / m^2)**	**Grain yield (g. $m^{2)}$**	**Straw yield (kg /m^2)**	**(1000 grain (g)**
T_1	81.88	1.40	305.15	1.0	20.98
T_2	78.50	1.21	290.45	0.92	19.76
T_3	91.80	1.68	420.30	0.95	24.94
T_4	90.70	1.55	390.25	1.02	22.27
T_5	85.40	1.44	326.14	0.92	23.75
T_6	82.60	1.32	309.20	0.97	21.55
T_7	96.60	1.92	318.02	1.02	24.43
T_8	94.30	1.68	323.11	0.98	22.09
T_9	99.64	1.94	451.42	0.95	26.10
T_{10}	90.17	1.78	417.70	0.94	24.21
T_{11}	108.5	2.14	499.78	0.89	30.17
T_{12}	97.3	1.92	485.82	0.91	25.81
L.S.D 5%	13.49	0.168	30.750	N.S	1.535

Due to 1000 grain weight, results confirmed that all treatments gave significantly higher values over the control treatment. However, the highest 1000 grain weight values were due to T_{11} treatment (75 Kg N + compost tea +*Azolla*+ yeast) (30.17g). T_9 , treatment (75 Kg N + *Azolla*+ yeast) (26.10g) and T_{12} treatment (50 Kg N + compost tea +*Azolla*+ yeast) giving (25.81g) non-significant difference between both of them. The highest value (1000 grains weight) T_{11} was significantly higher than all tested treatments. Both of T_9 and T_{12} of these high value were significantly higher than the control treatment.

Data in Table (3) indicated that the treatments of compost tea addition with different levels of urea (75 and 50 Kg N. Fed^{-1}) increased the plant high , grains yield and increased the weight of 1000 grains and also increased plant dry weight and straw yield compared the control (T_1) and T_2 . **Hendawy, *et al.* (2010)** revealed that beneficial effect of compost tea on plant may due to its direct nutrients supplying and / or its microbial functions.

N - P and K contents in grain and straw.

Results in Table(4) indicated that N, P and K contents in wheat grain and straw as affected by *Azolla*, yeast and compost tea applied as foliar application showed pronounced increased than control treatments. Data in Table (4) showed also that, the highest increased nitrogen content in grain and straw were occurred when the wheat were treated with T_{11} treatment (75 Kg N + *Azolla*+ yeast+ compost tea) as foliar application giving 1.91 N % in grain and 0.95 N % in straw. This high amount was relatively caught significantly level in comparison to all treatments except for T_7 treatment (75Kg N+ compost tea) for 1.85% grain nitrogen percentage and T_9 (75 Kg N + *Azolla*+ yeast) for straw nitrogen (0.84) percentage. This attitude led to conclude that the use of treatment T_{11} could economically satisfy the recommended level of nitrogen, T_{11} application increased significantly all the tested grain and straw nitrogen.

Table (4): Concentration of N, P and K in wheat grain and straw as affected by compost tea , *Azolla*, yeast and nitrogen fertilizers in saline soil (data was a mean two sesons)

Treatments	Grain			Straw		
	N%	P%	K%	N%	P%	K%
T_1	1.36	0.59	1.95	0.59	0.23	1.52
T_2	1.05	0.54	1.86	0.50	0.20	1.50
T_3	1.42	0.69	2.01	0.56	0.32	1.69
T_4	1.40	0.60	1.90	0.56	0.30	1.60
T_5	1.63	0.70	1.92	0.67	0.39	1.63
T_6	1.52	0.66	1.83	0.63	0.35	1.49
T_7	1.85	0.78	1.82	0.78	0.49	1.88
T_8	1.63	0.73	1.93	0.67	0.40	1.77
T_9	1.83	0.88	2.05	0.84	0.51	1.84
T_{10}	1.74	0.72	1.98	0.72	0.43	1.52
T_{11}	1.91	0.92	2.13	0.95	0.60	1.97
T_{12}	1.65	0.78	1.92	0.80	0.50	1.47
L.S.D 5%	0.266	0.179	N.S	0.181	0.114	0.144

The values of P and K concentrations of wheat grain and straw were significantly increased as affected by sources and rules of nitrogen combined with *Azolla*, yeast and compost tea fertilizer. Higher value of P and K concentrations for wheat grain and straw were achieved with the application T_{11} and T_9 treatments than the other treatments. Increasing nitrogen from 50 to 75 $KgFed^{-1}$ and *Azolla*, yeast and compost tea enhanced their effect on the studied P & K elements. The data in Table (4) showed that the application of T_{11} and T_9 resulted in significant effects on the concentration of P & K. The highest value of P and K concentration of wheat grain were determined with T_{11} being 0.92 P and 2.13 K % for grain and 0.60 P and 1.97 K % for straw while application of T_9 giving 0.88 P and 2.05 k % in grain and 0.51-1.84 K % in straw. Data in Table (4) also showed that P & K concentration in both grain and straw were affected by the treatment which could be arranged as follows: T11> T9 >T7 for all treatments.

Also compost tea application to different rates of urea increased the uptake of the three macronutrients especially the rate of (75 Kg N Fed^{-1}) in the grain and straw compared with the control (T_1 and T_2) my due to its direct nutrients supplying and / or its microbial function . The recorded values of N, P and K concentration by grains were 1.85 , 0.78 and 1.82 % for soil treated with compost tea combination (75 kg N Fed^{-1}) wherease the straw recorded 0.78, o.49 and 1.88 % . (**Al – Kahal *et al* ., 2009**). reported that compost tea is concentrated a liquid fertilizer and inoculum of beneficial microorganisms therefore, the simulative effect of compost tea may be attributed to the beneficial microbes present in compost tea. It is postulated by various investigators that microbes in compost bring about the enhancement of plant growth of yield by stimulating the mineralization of organic matter and by solubilizing nutrients tied – up on soil particles which in turn reduce the reliance on chemical fertilizers. Also, microbes extend the root system of plants and thereby improve nutrient uptake , plus increased food storage and soil respire .

Some soil chemical properties of the studied:

Application of compost tea, *Azolla*, yeast and different urea rates on some physicochemical saline soil properties after wheat harvesting are mentioned in Table (5). Inoculation of *Azolla*, yeast and compost tea are in combination with nitrogen (urea) levels increased the organic matter percentage of the soil over the control treatment (T_1) after wheat cultivation. The highest organic matter were obtained with application of T_{11}, T_{12}, T_9, T_{10} and T_3 being 1.21, 1.11, 0.96 % and 0.96 %. This was still higher than all the treatments. The results obtained in the current study are in harmony with_**Nazeer_and_Prassad_(1984)** who found that, added *Azolla* with soil builds up organic matter content.

EC and soil reaction pH :

The soil EC in all treatments showed in Table (5). Application of *Azolla* and urea 50 & 75 Kg N Fed^{-1} T_3 and T_4 slightly decreased the soil EC. (T_3 9.42 and T_4 9.62) as compared with the treatments T_9 (9.74). The use of treatments T_{11} and T_{12} decreased the soil EC (T_{11}: 8.79 and T_{12}: 8.80) than the other tested treatments and also as compared to the soil before wheat cultivation. These results were in harmony with **EL-Berashi (2008)** reported that the soil EC were slightly decrease than the control treatments.

The effect of applying *Azolla*, yeast and compost tea in pH of the soil saline in table (5). Application of T_{11},T_{12} and T_{10} slightly decrease the soil pH. The results in table (5)showed that the use of *Azolla*, yeast and compost tea T_{11},$T_{12,}$ T_3,T_4 and T_{10} decreased the soil pH (7.43, 7.30, 7.50, 7.63 and 7.7) than all treatments and also as compared to the soil pH before wheat cultivation, these results were in harmony with **EL-Shahat *et al.* (2007)** who found that incorporation of *Azolla* decreased the soil pH.

Macronutrients content in soil.

Data showed in Table (5) revealed that, plant treated with T_{11} exhibited the highest mean values of N, P and K than other treatments, Treatment T_{11} is considered as an available medium for most of beneficial microorganisms including nitrogen fixers, phosphorus and potassium solubilizing . Application of T_{11} play an important role of enhancing Cyanobacteria and bacterial count to fix more atmospheric nitrogen which reflected on the increase of N content in the soil. The same trend was observed with the increase of P and K solubilizing where they both led to increase of P and K contents.

Data in Table (5) showed that, nitrogen, phosphorus and potassium soil content were significantly increased when application T_{11} over all treatments. However the highest NPK content were 114.50 , 6.18 and 245 ppm respectively. This trend was previously confirmed by Abd El – Baky et al ., (2008) who reported that spraying wheat cultivated under salt stress condition with algae extracts increased the NPK content compaered to those received 100 % N dose without algal extract spraying. These finding were observed by **Strik and Staden (2003)** who explained that, incorporation of fresh or dry *Azolla* into soil increased significantly the soil organic matter, which in turn upon its decomposition by the soil microorganisms had released the macro and micronutrients into soil, leading to increase the soil available nitrogen.

Macronutrients N,P and K availability in the studied saline soil presented in table(5). Application of treatments T_{11} and T_9 were statistically significant by increased in N,P and K as compared to all tested treatments, data in Table (5) showed that treatment including *Azolla*, yeast, compost tea and 75 Kg N Fed^{-1} (T_{11}) gave the highest records of N,P, and K content giving 114.5 N, 6.18P and 245K ppm.

Data in Table (5) showed combination of compost tea with different rate of urea (T_7 , T_8) increased organic matter and decreased PH and EC and raised the availability of N, P and K over the control treatment . In general, it may be concluded that compost application increased soil organic matter, Ca^{2+} , Mg^{2+} , K^+ and P while C : N ratio was narrowed in acidic soil. Hence, there was a general increase in nutrient supplying capacity of soils **(Sarwar *al et*., 2010**).

Table (5): Effect of application, of compost tea, *Azolla* and yeast on some physicochemical properties of soil after wheat harvesting (data are means of two seasons)

Treatments	O.M %	E.C %	pH	Macronutrients (ppm)		
				N	P	K
T_0	0.64	11.70	8.25	64	4.89	177
T_1	0.66	11.80	8.26	66	5.03	179
T_2	0.65	11.80	8.23	63	4.90	183
T_3	0.96	9.42	7.50	79	5.11	211
T_4	0.86	9.62	7.63	65	5.18	206
T_5	0.74	11.60	8.10	68	4.96	185
T_6	0.79	11.60	8.05	68	4.80	179
T_7	0.78	11.45	7.92	81.1	5.22	206
T_8	0.81	11.55	7.86	70.1	5.08	200
T_9	0.96	9.74	7.50	99.18	6.04	221
T_{10}	0.96	10.04	7.70	86.20	5.03	219
T_{11}	1.21	8.79	7.43	114.50	6.18	245
T_{12}	1.11	8.80	7.50	95.35	5.60	210

Conclusion

The application of compost tea , *Azolla* and yeast in wheat cultivation can be considered as a promising technique bot to increase the wheat production and to provide protection from the environmental pollution caused by the extensive use of chemical fertilizers. Thus it may be inferred that compost tea, *Azolla* and yeast exhibited a better N availability to wheat than urea and it could act as a substitute nitrogen source for many crops other than urea.

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ثأثير شاى الكمبوست ، الأزولا والخميرة على محصول القمح فى الأرض الملحية

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أجريت تجربتين حقليتين لدراسة تأثير شاى الكمبوست والأزولا والخميرة منفردين أو مخلوطين فى وجود معدلات مختلفة من التسميد باليوريا وأثر ذلك على خواص التربة وإنتاجية القمح تحت ظروف الأراضى الملحية فى منطقة سهل الحسينية – محافظة الشرقية خلال الموسمين الشتويين عام (2008 – 2009) – (2009 – 2010) وقد تم إضافة اليوريا (75 كجم أزوت – 50 كجم أزوت) على التوالى. وقد دلت النتائج على ان زيادة معدل إضافة النيتروجين المعدنى من 50 إلى 75 كجم نيتروجين/ فدان فى وجود شاى الكمبوست أدى إلى زيادة الأعداد الكلية لكلاً من البكتريا والسيانوبكتريا مما أدى غلى زيادة معدل التنفس ومعدل ك أ2 بالإضافة غلى زيادة معدل كل من انزيم النيتورجنيز والهيدروجنيز. جميع المعاملات أدت إلى انخفاض رقم pH (الآس النيتروجينى) EC (كمية الملوحة) الناتج من تحليل التربة فى جميع المعاملات مما أدى إلى تحسين صفات التربة الفيزيقية وزيادة النشاط الميكروبى مقارنة بمعاملة الكنترول. سجلت المادة العضوية أعلى النتائج مع المعاملات T_{11} , T_{12} , T_9 , T_{10} , T_3. أدى استخدام المعاملة T_{11} إلى زيادة محتوى التربة من النيتروجين والفوسفور والبوتاسيوم بمعدل 114,5، 6,18 ، 245 جزء فى المليون على التوالى. لا يوجد تأثير معنوى ملحوظ فى زيادة طول النبات باستخدام T_9 , T_7 , T_{12} على التوالى حيث سجلت هذه المعاملات 97,3 ، 96,6 ، 99,64 سم / نبات. إضافة شاى الكمبوست مع معدلات مختلفة من النيتروجين أدى إلى زيادة فى طول النبات وإنتاج الحبوب ووزن الـــ 1000 حبة، والوزن الجاف وإنتاجية القش مقارنة بالكنترول T_2 , T_1 . سجلت المعاملة T_{12} (50كجم نيتروجين + شاى الكمبوست + الأزولا + الخميرة) 485,82 جم/م2 لوزن الحبوب. سجلت T_{11} 499,78 أعلى قيمة عن باقى المعاملات لوزن الـ 1000 حبة مقارنة بجميع المعاملات. سجلت كل من T_{11} , T_9 أعلى قيمة للفوسفور والبوتاسيوم لكلاً من الحبوب والقش. سجلت التربة المعاملة بشاى الكمبوست ، 75 كجم نيتروجين للفدان أعلى تركيز للنيتروجين والفوسفور والبوتاسيوم فى الحبوب 1,85 ، 0,78 ، 1,82 % .