Review Paper

Role integrated mineral fertilizers and bio-fertilizers on some soil properties, behavior nutrients in rice plant and rice productivity under newly reclaimed saline soil conditions

ABSTRACT

A field experiment was conducted during to successive summer seasons 2016 and 2017 at Sahl El-Houssinia Agriculture Research Station in El-Shakia Governorate, Egypt. Its lies between 32^o 00/00 to 32^o 15/00/ N latitude and 30^o 50 / 00// to 31^o 15 00// E longitude (map 1). Evaluation the combined effect of bio-fertilizers inoculated with *Rhizobium radiobacter* sp strain (salt tolerant PGPR); *Bacillus megatherium* (dissolving phosphate) and *Bacillus circulans* (enhancing potassium availability) and Yeast strains (*Saccharomyces cerevisiae*) combined with different rates of N, P and K fertilizers (50, 75 and 100 %) on some soil properties; nutrients content in rice plant and rice productivity under newly reclaimed saline soils conditions. Rice (*Oryza sativa) var*. Sakha 101 grains were obtained from the crop field of the Agric. Res. Inst. (ARC), Egypt. The experiment was conducted in Randomized complete blacks with three replicates.

The obtained results indicated that the decrease of soil pH and EC for soil treated with bio-fertilizers combined with different rates of mineral fertilizers compared with soil treated with yeast and control. The increases of available N, P, K, Fe, Mn and Zn in soil as affected with bio-fertilizers combined with increasing mineral fertilizers rate. The applied of three treatments i.e. mineral fertilizers (N, P and K) alone or combined with bio-fertilizers (bacteria) and yeast to the soil cultivated with rice were increase yield grains and straw of rice plant. The different rates of

mineral fertilizers was increase for the plant height (cm), panicle length (cm), 1000 grains (g), grains yield (ton/fed) and straw yield (ton/fed) with soil treated with bacteria + 75 % N+P+K fertilizers compared with other treatments. The increase of macro-micronutrients concentration and uptake in grains and straw for soil treated with bacteria + 75 % N+P+K fertilizers compared with other treatments.

Recommendation: we can used the bacteria *Rhizobium radiobacter* **(**fixed N**) ,** *Bacillus megatherium* (dissolving phosphate) and *Bacillus circulans* (enhancing potassium availability) combined with 75 % mineral fertilizers (N,P and K) were improve soil properties and healthy grown rice production under saline soil conditions.

Key word: saline soil; compost; wheat crops; nutrients contents in soil and rice plant.

INTRODUCTION

Today with an increase in food demand one of the major issues of global concern is food security with rising populations and restricted lands under cultivation as a result of increasing land use for urbanization and industrialization. With the advent of green revolution in 1960, intensive agricultural practices that come into existence include use of high-yielding, disease-resistant crop varieties, and constant input of agrochemicals such as chemical fertilizers, pesticides etc. Application of such chemicals adversely affects the dynamic equilibrium of soil and affects agro-biodiversity by destroying non target useful soil flora and fauna **Bambaradeniya and Amerasinghe (3003) and Galhano et al (2011).**

Rice grain average content is 80% starch, 7.5% protein, 0.5% ash and 12% water. The proportion of amylose and amylopectin in starch determines the cooking and eating qualities of the rice. Rice is a primary source of carbohydrate and the essential amino acids in sufficient amounts for good health**, Wu et al (2003).**

The yeast *(Saccharomyces cerevisiae)* is rich in amino acid, proteins, carbohydrates, minerals, vitamins, hormones and other growth regulating substances **(Omran, 2000). Marzauk et al (2014)** indicated that the application of yeast extract treatments concentration of 6 ml/L foliar was increasing plant growth, expressed as plant length (cm), number of leaves and branches as well as fresh and dry weight (g) of leaves, branches and whole plant in both two seasons as compared with the other studied.

Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilize insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization **(Venkatashwarlu, 2008).** The improve of plants growth in response to the foliar application of yeast extract may be attributed to its contents of different nutrients, i.e. (P, K, Mg, Ca, Fe, Ba, Mn and Zn), higher percentage of proteins, higher values of free amino acid and vitamins which may play an important role in improving growth and controlling the incidence of fungi diseases **(Bevilacqua, et al., 2008)**. The soluble protein content increases as result of yeast action. On the other hand the yeast releases amino acids from the soluble protein, while on the other hand it grows and utilizes a part of the amino acids content **(Anca, et al, 2011).**

This the study aims to investigate the evaluation of applying bio-fertilizers and yeast combined with different rates of mineral fertilizers on some soil properties and macro-micronutrients contents in rice plant and rice productivity under saline soil conditions.

MATERIALS AND METHODS

Study area:

The area under investigation locates at Sahl El-Houssinia Agriculture Research Station in El-Shakia Governorate, Egypt. Its lies between 32^o 00/00 to 32^o 15/00/ N latitude and 30^o 50 / 00// to 31^o 15 00// E longitude (map 1). Salts accumulation being took place, mainly due to high evaporation under dry hot climate. El-salam canal (1:1mixed of Nile and agriculture daring water being the main source of irrigation water.

Prior the experimental conducting some farming processes were carried out including the following:

- **a)** Leveling the soil surface using lazier technique;
- **b)** Deep sub-soil ploughing;
- **c)** Establishment of require surface drains and irrigation canal network systems;

Collecting representatives surface soil sample for conducting some physical and chemical analysis according to **Page et al (1982) and Cottenie (1982).** Data in table (1) show some physical and chemical properties of the initial soil.

Table (1) Physical and chemical properties in soil study before rice

Crosse sand (%)	Fin sand (%)	Silt (%)	Clay (%)		Texture	O.M (%)		$CaCO_3$ (%)
4.57	33.95	15.58	45.90		Clay	0.58		9.33
F.C.	W.P.	A.W.	B.D (g/cm^3)			T.P (%)		
28.39	10.56	12.90	1.45			43.00		
Chemical properties								
pH (1:2:5)	EC (dS/m)	Cations (meq/l)				Anions (meq/l)		
		Ca^{++}	Mg^{++}	Na^+	K^+	HCO^-_3	Cl^-	SO^{--}_4
8.12	9.90	12.50	20.31	65.40	0.79	7.49	48.38	43.13
Macronutrients (mg/kg)			Micronutrients (mg/kg)					
N	P	K	Fe	Mn	Zn	Cu		
32.55	3.64	170	4.58	1.07	0.60	1.11		

Experimental work:

The current experiment was conducted during two successive summer seasons (2016 and 2017) respectively, in clay saline soil.

Fertilizer treatment:

Minerals and bio-fertilizer treatments are given in Table (2).

Treatment	Rate of N^{*} Kg/ fed	Rate of $P_2O_5^{**}$ Kg/ fed	Rate of K_2O kg/fed
Mineral	0.0	0.0	0.0
	50	15	35
	75	25	55
	100	31	70
***Bacteria	0.0	0.0	0.0
	50	15	35
	75	25	55
	100	31	70
***Yeast	0.0	0.0	0.0
	50	15	35
	75	25	55
	100	31	70

*Urea 46% N is source of N
**Super phosphate 15.5% p_2O_5 is a source of P
*** Potassium sulphate (48 % K_2O) source of K
****Bacteria and Yeasts were given from microbiology Department, SWERI, Agric. RES. center, Giza, Egypt.
***** Grains of rice cultivar Giza 104 were obtained from Crop Institute Agriculture Research Center, Giza, Egypt.

Experimental Design:

The experiment was conducted in Randomized complete blacks with three replicates. The used two bio-fertilizers (i.e. yeast and bacteria) were randomly ranged as a main plot, where the rates of N, P and K were distributed randomly as sub plot. The experimental unit area was 5m long X 10m width and 50 cm. The experimental area was divided into three divisions (mineral fertilizers, yeast and bacteria). Super phosphate rates were applied during soil tillage and plots were ploughed twice after super phosphate application.

Grains were inoculated with *Rhizobium radiobacter* sp strain (salt tolerant PGPR) biofertilizer deposited in the Gen bank under number of HQ395610 Egypt ; *Bacillus megatherium* (dissolving phosphate) and

Bacillus circulans (enhancing potassium availability) and Yeast strains (*Saccharomyces cerevisiae*) by Bio-fertilizers Production Unit, Department of Microbiology, Soils, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt.

Rice (*Oryza sativa*)var. Sakha 101 grains were obtained from the crop field of the Agric. Res. Inst. (ARC) , Egypt.

Sowing of rice grains was carried out 28 April (2016 and 2017). The grains divided into without or with coated. Under bacteria or yeast treatment, the grains were inoculated at sowing. The coating grains processes were carried out using Arabic gum solution. As well as, staking agent more biofertilizers were added three periods, at 30, 55 and75 days from sowing through liquid foliar application on soil and plants at a rate of 20L/400Lwater /fed.

Nitrogen fertilizer rates were added as urea (46 % N) in three times 21, 45 and 65 days after sowing grains. Potassium sulfate (48 % K_2O) was applied as base fertilizer for all treatments at rate of 50 kg K_2O /fed were applied in two doses being 21 and 55 days from sowing grains.

All experimental plots were irrigated with El-Salam Canal (1:1) Nile water mixed with agriculture drainage water. To control soil salinity, water was applied immediately after sowing for 7 hours and then the excess water was surface drained. The same process was repeated in second day. Irrigation water was applied every 12 days until the end of growing season.

Rice grains crop was harvested on 5 September 2016 and 2017 of each growing seasons. At harvest, the following parameters were recorded on a random sample of ten plants from each plot, seed yield (ton/fed), pod yield (ton/fed), weight of 100 seeds (gm)

Sample of rice grains were oven dried at 70 C^o crushed then wet ash using of H_2SO_4 mixed with $HCLO_4$ acids , then in aliquots of digested solution , macro –micronutrients concentration were determined by **Cottenie et al (1982)** and **Chapman and Pratt (1961)**.

Photosynthetic Chlorophyll (a+b) was estimated in fresh leaves as described by **Witham et al (1971**) Proline content was estimated according to methods by **Bates et al (1973).**

The obtained data were statically analysis using the COSTAT program and LSD test at probability levels of 5 % calculated according to **Gomz and Gomez (1984).**

Results and Discussion

Soil pH.

Soil pH is one the most important parameters which reflect the overall changes in soil chemical properties. Data presented in Table (2) show that the initial state of soil, in general, exhibits the high pH value 8.25 in soil surface. The soil pH tends to increase slightly after the rice harvested under all treatments. Soil pH is also known to be affected by bio-fertilizers. The soil pH of all experimental ranged was slightly to moderately alkaline conditions. The soil pH value is always around 8.25 to 7.95. Reduction in soil pH may be related to the residual organic after different biochemical and chemical changes. In addition the active of microorganisms led to produce organic acid released from the bio-fertilizers. From these data, it observed that the soil pH decreased as results of using bacteria followed by yeast and mineral fertilizer, respectively compared with the initial state of soil. These results are in agreement by **Shaban and Omar (2006) and Hafez (2014)** indicated that the reducing effect of bio -fertilizer combined with mineral nitrogen might be attributed to associated increase in activity of dehydrogenase enzyme as well as the release of carbon dioxide in the rhizosphere due to exhalation of the microorganisms. **Shaban and Attia (2009)** found that bacteria that fixed N_2, dissolved P and available K led to a decrease in soil pH when added alone or in combination with chemical fertilizers.

Soil salinity (EC dSm^{-1}).

The EC (dSm^{-1}) values of studied soils after rice harvest, data in Table (2) reveal that the EC values of studied in all studied had tend to decrease by soil treated with mineral fertilizers combined with bio-fertilizers compared with soil treated with mineral fertilizers alone. The effect of all treatments on soil salinity were no significant while the different rates mineral fertilizers were significant decreases with increasing rate of mineral fertilizers. The interaction between bio-fertilizers combined with mineral fertilizers was significant increase on decrease soil salinity after rice harvest.

Table (2). Effect of different rate of mineral N, P and K fertilizers combined with bio-fertilizer on pH, EC and macro-micronutrients in soil after rice harvested.

Treatments	Rate of NPK (%)	pH (1:2.5)	EC (dSm^{-1})	Macronutrients (mg kg^{-1})			Micronutrients (mg kg^{-1})		
				N	P	K	Fe	Mn	Zn
Mineral	0	8.05	6.89	38.99	3.51	180.00	5.90	1.33	0.79
	50	8.03	6.45	41.45	3.66	186.00	5.97	1.38	0.83
	75	8.01	5.80	42.30	3.80	195.00	6.05	1.45	0.86
	100	8.00	5.30	44.28	3.95	198.00	6.12	1.56	0.87
Mean		8.02	6.11	41.76	3.73	189.75	6.01	1.43	0.84
Bactria	0	8.03	6.40	40.55	3.75	187.00	5.93	1.40	0.84
	50	8.01	5.98	43.58	3.90	195.00	6.04	1.65	0.88
	75	7.98	5.27	44.23	4.05	202.00	6.10	1.70	0.97
	100	7.95	4.75	46.88	4.17	205.00	6.15	1.79	0.99
Mean		7.99	5.60	43.81	3.97	197.25	6.06	1.64	0.92
Yeast	0	8.04	6.73	40.00	3.65	185.00	5.91	1.38	0.82
	50	8.02	6.35	41.65	3.80	189.00	5.98	1.50	0.85
	75	8.00	5.75	42.90	3.93	194.00	6.06	1.63	0.88
	100	7.98	5.22	44.89	3.98	198.00	6.13	1.75	0.93
Mean		8.01	6.01	42.36	3.84	191.50	6.02	1.57	0.87
LSD. %5 treatment		--	ns	ns	ns	ns	ns	0.021	ns
LSD. 5 %Rates		--	0.51	ns	ns	ns	ns	0.024	0.016
Interaction		--	**	*	ns	ns	ns	**	**

The corresponding relative decreased of mean values (EC dSm^{-1}) were 8.34 % for soil treated with bio-fertilizers combined different rates of mineral fertilizers and 0.16 % for soil treated with yeast combined with mineral fertilizers different rates compared with soil applied mineral fertilizers different rates. These results confirmed more over by **Vishal et al. (2013) and Ali et al (2014)** they suggested that organic acids are produced by the bacterial endophytes like indol acetic acid, gibberellic acid, and abscisic acid etc. support plant growth by solubilization of minerals and by root growth promotion and lowering the EC in the rhizosphere and these organic acids provided a substantial modification of soil physical and chemical properties.

It is worthily to mention that the superiority of bacteria combined with different mineral fertilizers rates as compared to the other treatments is more related to the occurrence of active organic acids that released from the activity of microorganisms. These bio-fertilizers provided a substantial modification of soil physical properties, especially soil structure as well as soil aggregation and drainable pores. Consequently, these favorable conditions are positively affected soil permeability and encourage the downward movement of leaching water**.**

Macronutrients available in soil.

Data presented in Table (2) show that the bacteria and yeast fertilizations combined with mineral fertilizers different rates were positive effect on N, P and K availability in soil. Moreover, show that the soil treated with bacteria combined with mineral N, P and K fertilizers at the high rates gave higher values of available N, P and K in soil than other treatments. On the other hand, the effect of different rates of mineral fertilizers on available N, P and K content in soil and bio-fertilizers were no significant, while the interaction between mineral fertilizers and bio-fertilizers were significant affect on N available in soil. Also, the relative increases of mean values were 4.91 % for N; 6.43 for P and 3.95 % for K contents in soil as affected by bacteria combined with different rates of mineral fertilizers compared with mineral fertilizers alone. As, well as, the relative increases of mean values N, P and K available in soil as affected with yeast combined with different rates mineral fertilizers were 1.44 % for N ; 2.95 % for P and 0.92 for K respectively compared with mineral fertilizers alone. These results are in similar to those found by **Abeer and Hanaa (2008)** who found that the bio-fertilizer inoculation generally increased the concentration of N, P and K in soil as compared to control. **Hafez (2014)** indicated that the application of bio-fertilizers on available contents of N, P and K in soil after harvest did not show a significant effect. **Rifat et al. (2010)** reported that PGPR as a bio-fertilizer helps in fixing N_2, solubilizing mineral phosphates and other nutrients as well as enhancing tolerance to stress.

Micronutrients available contents in soil after rice harvest.

The recorded data presented in Table (2) show that the different fertilizations sources were positive effect on micronutrients available in soil (Fe, Mn and Zn, mg/kg soil). Concerning, it was also shown in studied soil treated with bacteria and yeast combined with mineral fertilizers rates gave increase values of available Fe, Mn and Zn than treated with mineral fertilizers alone. The effect of bio-fertilizers combined with mineral fertilizers on Fe and Zn were no significant, while the significant for Mn. Moreover, the applied of mineral fertilizers different rates to soil led to significant increases for Mn and Zn contents in soil. The interaction between bio-fertilizer and mineral fertilizers on available Mn and Zn contents in soil gave significant, while, Fe was no significant. This result suggested the important role of bio-fertilizers in improving soil nutrients status due to microorganism's activity in N Fixation; P solublization and K. These results agreement by **Wu et al (2006)** who found that, the activity of bacteria *Azotobacter chroococcum*, *Bacillus megatherium* and *Bacillus mucilaginosus*, led to an increase of water dissolved organic carbon concentration and a decreased pH value, which enhanced metal mobility and bio-availability. **Shaban and Attia (2009)** found that the Bio-fertilizers including *Azospirillum brasilense NO 40*, Bacillus *megatherium* and *Bacillus circularns* in combination with chemical fertilizers, may have positive impact on bio-availability and mobility of micronutrients in soil, depending on the chemical nature of metals.

Yield and yield components.

The effect of mineral fertilizers and bio-fertilizers or yeast on yield and yield components i.e. plant height (cm), panicle length (cm), 1000 grains (g), grains yield (ton/fed) and straw yield (ton/fed) were presented in Table (3). Results showed that applied of three treatments i.e. mineral fertilizers (N, P and K) alone or combined with bio-fertilizers (bacteria and yeast) to the soil cultivated with rice were no significant for yield and yield components of rice growth. The different rates of mineral fertilizers was significant increase for the plant height (cm), panicle length (cm), 1000 grains (g), grains yield (ton/fed) and straw yield (ton/fed) with increasing rates without bacteria. **Liang et al (2007)** suggests that mineral nutrient status of plants plays a crucial role in increasing plant resistance to environmental stresses including salinity. The effect of different applied mineral fertilizers rates either with or without yeast application gave increases markedly for the plant height (cm), panicle length (cm), 1000 grains (g), grains yield (ton/fed) and straw yield (ton/fed) with increasing rates, while the decreased of mineral fertilizers combined with bacteria led to increasing the plant height (cm), panicle length (cm), 1000 grains (g), grains yield (ton/fed) and straw yield (ton/fed). The relative increases of mean values were 6.18 % for plant height (cm) ; 20.18 % for panicle length (cm); 11.46 % for 1000 grains (g) ; 18.49 for yield grains ton/fed and 25.08 for straw yield ton/fed for soil treated with mineral fertilizers combined with bacteria than soil treated with mineral fertilizers alone. As well as, the relative increases of mean values were 4.63, 5.13, 4.87, 3.40 and 12.23 % for the plant height (cm), panicle length (cm), 1000 grains (g), grains yield (ton/fed) and straw yield (ton/fed) respectively, as affected by mineral fertilizers combined with yeast application compared with mineral fertilizers alone. **Shaban et al (2009)** found that the increase of grains and straw rice yields to be due to production of sme material with bio-fertilizers which may have activated microorganisms and improved soil fertility.

Table (3). Yield and yield component of rice as affected by bio-fertilizer and different fertilization under saline soil conditions

Treatments	Rate of NPK (%)	Plant height (cm)	Panicle length (cm)	1000grain weight (g)	Grains yield weight (ton/fed)	Straw yield weight (ton/fed)
Mineral	0	54.22	12.85	21.95	0.759	0.894
	50	75.39	15.62	24.63	2.480	3.390
	75	80.45	16.32	27.95	3.650	4.285
	100	82.00	16.85	28.12	3.720	4.194
Mean		73.02	15.41	25.66	2.65	3.19
Bacteria	0	61.28	16.58	26.14	0.846	1.193
	50	80.49	17.66	28.69	3.145	3.856
	75	84.36	20.52	30.42	4.592	5.690
	100	84.00	19.32	29.14	3.970	5.237
Mean		77.53	18.52	28.60	3.14	3.99
Yeast	0	58.33	14.85	25.41	0.592	1.056
	50	79.85	15.99	26.95	2.637	3.660
	75	83.46	16.45	27.34	3.840	4.590
	100	83.95	17.52	27.94	3.880	5.012
Mean		76.40	16.20	26.91	2.74	3.58
LSD. %5 treatment		ns	ns	ns	ns	ns
LSD. 5 %Rates		1.48	1.72	1.45	0.54	0.47
Interaction		***	***	**	**	**

Generally, the improve rice growth in soil salinity may be due to the enhancing effect of bio-fertilizers (yeast and bacteria) on growth plants characters produced cytokinins, which enhancing the accumulation of soluble metabolites, increasing the levels of endogenous hormones in treated plants, which could be interpreted by cell division and cell elongation, increasing the metabolic processes rate and levels of hormones (Indol acetic acid IAA and gibberellins GA3) in addition to the physiological roles of vitamins and amino acids in the bio-fertilizers strains.

Macro-micronutrient concentration and uptake in grains rice.

Bio-fertilizers (PGPR) has ability to increase the availability of nutrients concentration in the rhizosphere by fixing N; ability solubilize phosphate and availability of K. Data presented in Tables (4 and 5) show that the effect of mineral fertilizers alone or bacteria and yeast on N, P, K, Fe, Mn and Zn concentration in grains rice were no significant, while the applied of mineral fertilizers rates combined with bio-fertilizers were significant increases expect K concentrations in grains. The interaction between bio-fertilizers and different rates of mineral fertilizers on N, P, Fe, Mn and Zn concentration in grains rice were significant increase, while the K was no significant. On the other hand, the N, Fe and Zn uptake in grains rice were significant for soil treated with mineral nitrogen fertilizers or bacteria and yeast fertilizers than P, K and Mn were no significant. Also, the uptake of N, P, K, Fe, Mn and Zn in grains rice was significant in soil treated with mineral fertilizers rates. As, well as, the interaction between mineral fertilizers different rates and bio-fertilizers led to significant increase of N, P, K, Fe, Mn and Zn Uptake in grains rice. The application of bacteria combined with 75 % N, P, K mineral fertilizers caused an increases of N, P, K , Fe, Mn and Zn concentration and uptake in grains rice plants compared other treatments. These results are in agreement by **shaban and Attia (2009)** suggested that the concentration of N, P, K, Fe, Mn and Zn in grains maize when added bio-fertilizer was in combination with chemical fertilizers.

Table (4). Effect of different rate of mineral N, P,K fertilizers combined with bio-fertilizer on concentration of macro-micronutrients in grains of rice harvested.

Treatments	Rate of N PK (%)	Macronutrients (%)			Micronutrients (%)		
		N	P	K	Fe	Mn	Zn
Mineral	0	1.20	0.38	1.95	85.42	65.98	18.94
	50	1.26	0.39	2.04	89.24	68.52	22.14
	75	1.34	0.45	2.08	93.40	72.16	25.63
	100	1.39	0.48	2.14	95.34	75.10	28.17
Mean		1.30	0.43	2.05	90.85	70.44	23.72
Bacteria	0	1.48	0.45	2.04	88.65	69.24	20.14
	50	1.52	0.48	2.09	92.14	72.16	25.36
	75	1.63	0.58	2.17	99.13	79.25	32.46
	100	1.59	0.52	2.13	95.62	76.34	29.45
Mean		1.56	0.51	2.11	93.89	74.25	26.85
Yeast	0	1.25	0.41	1.98	86.59	68.25	19.58
	50	1.30	0.46	2.04	92.14	70.14	24.34
	75	1.35	0.49	2.08	95.24	73.24	27.75
	100	1.45	0.51	2.15	96.24	77.36	30.94
Mean		1.34	0.47	2.06	92.55	72.25	25.65
LSD. %5 treatment		ns	ns	ns	ns	ns	ns
LSD. 5 %Rates		0.056	0.022	ns	2.54	2.14	2.19
Interaction		**	**	ns	**	**	**

Table (5). Effect of different rate of mineral N P K fertilizers combined with bio-fertilizers on uptake of macro-micronutrients in grains of rice harvested.

Treatments	Rate of NPK (%)	Macronutrients (kg/fed)			Micronutrients (g/fed)		
		N	P	K	Fe	Mn	Zn
Mineral	0	9.10	2.90	14.80	64.83	79.18	14.38
	50	31.20	9.70	50.60	221.32	86.34	54.91
	75	48.90	16.40	75.90	340.91	96.69	93.55
	100	51.70	17.90	79.60	354.66	104.39	104.79
Mean		35.23	11.73	55.23	245.43	91.65	66.91
Bacteria	0	12.50	3.80	17.30	75.00	102.48	17.04
	50	47.80	15.10	65.70	289.78	109.68	79.76
	75	74.8	26.60	99.60	455.20	129.18	149.06
	100	63.10	20.60	84.60	379.61	109.68	116.92
Mean		49.55	16.53	66.80	299.90	112.76	90.70
Yeast	0	7.40	2.40	11.70	51.26	85.31	11.59
	50	34.30	12.10	53.80	242.97	91.18	64.18
	75	51.80	18.80	79.90	365.72	98.87	106.56
	100	56.30	19.80	83.40	373.41	112.17	120.05
Mean		37.45	13.28	57.20	258.34	96.88	75.60
LSD. %5 treatment		3.28	ns	ns	4.08	ns	4.40
LSD. 5 %Rates		3.78	3.18	4.15	4.71	4.14	5.10
Interaction		**	**	**	**	**	**

Mishra et al (2013) reported that the biofertilizer is a mixture of live or latent cells encouraging nitrogen fixing, phosphate solubilizing, or cellulolytic microorganisms used for applications to soil, seed, roots, or composting areas with the purpose of increasing the quantity of those mutualistic beneficial microorganisms and accelerating those microbial processes, which augment the availability of nutrients that can then be easily assimilated and absorbed by the plants.

Macro-micronutrients concentrations and uptake in straw rice plants.

Data presented in Tables (6and7) show that the macro-micronutrients contents in straw rice plants under different biofertilizers and mineral fertilizers different rates under soil salinity conditions. The data obtained of N, P, K, Fe, Mn and Zn concentrations and uptake were decreases with treated mineral fertilizers without bacteria and yeast application. The all treatments for studied were no significant affect on N, P, K, Fe, Mn and Zn concentrations in straw while the Zn and Fe uptake were significant effect of all treatments. The different rates of mineral fertilizers were significant increases of N, P, K, Fe, Mn and Zn concentrations and uptake in straw rice plants. The interaction between bio-fertilizers and mineral fertilizers were significant increase of N, P, K, Fe, Mn and Zn concentrations and uptake in straw rice plants. The highest mean value of N, P, K, Fe, Mn and Zn concentrations and uptake in straw rice plants were soil treated with bacteria combined with mineral fertilizers than other treatments. These results are in agreement by **Haum et al (2007**) found that the increase of N, P and K concentrations in straw rice by soil treated with bio-fertilizer combined with mineral fertilizer different rates could be due to changes in soil chemical properties , microbial population and biochemical soil enzymes activities in saline soil cultivation. **Ashmaye et al (2008)** indicated that the application of

Table (6). Effect of different rate of mineral N , P and K fertilizers combined with bio-fertilizer on macro-micronutrients in straw of rice harvested.

Treatments	Rate of NPK (%)	Macronutrients (%)			Micronutrients (mg/kg)		
		N	P	K	Fe	Mn	Zn
Mineral	0	1.94	0.23	2.18	72.68	59.47	17.45
	50	1.98	0.27	2.22	77.52	61.30	20.41
	75	2.04	0.29	2.29	82.14	65.82	21.69
	100	2.09	0.32	2.35	85.36	69.52	22.74
Mean		2.01	0.28	2.26	79.43	64.03	20.57
Bacteria	0	1.98	0.26	2.23	74.52	63.14	18.20
	50	2.16	0.29	2.28	79.32	69.52	21.35
	75	2.22	0.31	2.32	85.20	70.41	24.13
	100	2.28	0.35	2.38	89.14	71.00	25.69
Mean		2.16	0.30	2.30	82.05	68.52	22.34
Yeast	0	1.97	0.24	2.20	72.96	61.38	18.00
	50	2.13	0.28	2.26	80.52	65.24	20.55
	75	2.18	0.30	2.28	81.00	69.22	20.95
	100	2.24	0.33	2.31	82.41	70.41	21.05
Mean		2.13	0.29	2.26	79.22	66.56	20.14
LSD. %5 treatment		ns	ns	ns	ns	ns	ns
LSD. 5 %Rates		0.07	0.023	0.031	1.73	2.88	1.64
Interaction		**	**	***	***	***	**

Table (7). Effect of different rate of mineral N , P and K fertilizers combined with bio-fertilizer on macro-micronutrients uptake in straw of rice harvested.

Treatments	Rate of N PK (%)	Macronutrients (kg/fed)			Micronutrients (g/fed)		
		N	P	K	Fe	Mn	Zn
Mineral	0	17.30	2.10	19.50	64.98	53.17	15.60
	50	67.10	9.20	75.30	262.79	207.81	69.19
	75	87.40	12.40	98.10	351.97	282.04	92.94
	100	87.70	13.40	98.60	358.00	291.57	95.37
Mean		64.88	9.28	72.88	259.44	208.65	68.28
Bacteria	0	23.60	3.10	26.60	88.90	75.33	21.71
	50	83.30	11.20	87.90	305.86	268.07	82.33
	75	126.30	17.60	132.00	484.79	400.63	137.30
	100	119.40	18.30	124.60	466.83	371.83	134.30
Mean		88.15	12.55	92.78	336.60	278.97	93.91
Yeast	0	20.80	2.50	23.20	77.05	64.82	19.01
	50	78.00	10.20	82.70	294.70	238.78	75.21
	75	100.10	13.80	104.70	371.79	317.72	96.16
	100	112.30	16.50	115.80	413.04	352.89	105.50
Mean		77.80	10.75	81.60	289.15	243.55	73.97
LSD. %5 treatment		ns	ns	ns	4.38	ns	1.37
LSD. 5 %Rates		3.12	1.40	32.16	5.06	27.11	1.58
Interaction		***	***	**	**	**	**

the bio-fertilizer in combination with mineral fertilizer caused increases in the concentrations of Fe, Mn and Zn in straw.

Thus, it could be concluded that the concentration and uptake of macro- micronutrients in grains and straw rice plants reflected to availability in soil and the applied fertilizers sources.

CONCLUSION

Chemical and microbial fertilizer has its advantages and disadvantages in terms of nutrient supply, soil quality and crop growth. As well, biological fertilization with N_2 fixing bacteria, phosphorus solubilizing bacteria and potassium dissolving bacteria are of great importance in increasing crop production and saving mineral fertilizers. Moreover, inoculation of plants grown in salt affected soils with Salt-tolerant microorganisms offered them tolerance against salinity, thereby increased their production. It can be concluded that biofertilization by *Rhiobium radiobacter* sp strain, *Bacillus megatherium* as (dissolving phosphate bacteria) and *Bacillus circulans* inoculants could be applied to faba bean as a supplement to inorganic NPK-fertilizer. Considerable increase was observed when plants were treated with bio inoculation + 75% NPK-recommended by the Ministry of Agriculture. It could be recommended that salt tolerant plant growth promoting rhizobacteria (PGPR) should be used to face the problem of salinity or excessive NPK-mineral use for the rice plants.

Pictures: 1- soil treated with mineral fertilizers – 2- yeast combined with mineral fertilizers – 3- bacteria combined with mineral fertilizers

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