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EFFECT OF MINERAL NITROGEN RATES AND BIO-FERTILIZATION ON SOME SOIL PROPERTIES AND WHEAT PRODUCTIVITY AT SAHL EL-TINA PLAIN

Kh . A. Shaban and A. H. Abd El-Rhman

Soils, Water and Environment Research Institute, Agric. Res. Centre Giza, Misr (Egypt)

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ABASTRACT: *A field experiment was carried out at Sahl El-Tina plain (village,7) during the successive season of 2006 .The study aim to illustrate the effect of N rates (urea 46%) and bio-fertilization [Azospeirillum braselence (salt tolerant PGPR strain) and Azotobacter chroccocum strains] on the saline soils properties and wheat yield (Triticum aestivium c.v Sakha 93) productivity. Three levels of N fertilizer (28, 38 and 46 kg N /fed) as urea were used as main plots, inoculation with (Azospeirillum braselence and Azotobacter chroccocum strains) sub- plots. All treatments received the recommended doses of mineral phosphorus and potassium fertilizers. The results could be summarized as follow:*

1. *Soil pH and EC (dSm^{-1}) were decreased due to bio-fertilizers treatment at both rate of urea compared with un inoculation.*
2. *Available N, P and K in soil were increased by increasing N–rate plus bio-fertilization, than those obtained by each applied alone.*
3. *N – rates and bio-fertilizers treatment were Increased the grains and straw of wheat.*
4. *The interaction between N rates addition and bio-fertilizers were increased grain, straw yield, weight of 1000 grains and concentration of NPK in straw and grains in wheat crop compared with un inoculation*

Key words: *Nitrogen fertilizer, bio-fertilizer, saline soil and wheat productivity.*

INTRODUCTION

Saline soils were greatly varied in the salts composition. The dominant salts in the coastal soils are chlorides, mainly sodium chloride. The agriculture consideration was given when irrigation water was applied from El-Salam Canal in this region, poses numerous challenges. Water quality, soil reclamation stage and to recommend the agricultural practices which could be applied for each suggested crops, were a principal factors which help farmers in crops cultivation choice based (El- Refaie and Fahmy. 2005).

Agriculture security in Egypt depends largely on the horizontal extension. Improving and amelioration of sodic saline soils in Egypt is considered as an important part in the agriculture security program, (Abou Yuossef 2001).

Zaghloul *et al.* (1996) indicted that nitrogen contents were higher in case of bio-fertilization (*Azospeirillum*) than inorganic N fertilization in soil rhizosphere of wheat plants. Subba Rao (1999) found that bio-fertilizers(*Azospeirillum*) are carried based preparations containing beneficial microorganisms in available state intended for seed or soil application and designed to improve soil fertility and help plant growth by increasing the number and biological activity of desired microorganisms in the root environment. Zaghloul (1999) showed that caraway seed inoculation with *Azotobacter chrococcum* and provided with the half dose of inorganic N fertilizer gave the highest values of N, P and K compared with other treatments. Sushila and Giri-Gajendra (2000) found that bio-fertilization by *Azospeirillum* and *Azotobacter* had enhanced growth and yield of wheat. Samaliva, *et al.* (2002) studied the economic evaluation of wheat inoculation with *Azospeirillum* in field conditions. The affectivity of the use of bacterial suspension was studied with 4 levels of N (0, 8, 14 and 20 kg N), where the increase in production due to inoculation was 10.2 % compared to the variations without inoculation. Mostafa (2003) found that increasing nitrogen application rates to 150 kg N/fed caused highly significant decreased in both EC and ESP values. Shaban and Helmy (2006) revealed that the soil pH and EC was decreased when the nitrogen applied with *Azospeirillum braselence* and *Azotobacter chroccocum* strains). The decreases were higher than the nitrogen was applied individually. Salama (2006) reported that the application of bio- fertilizers plus inorganic N- fertilizers increased the N, P and K content (mg/plant) in whole parts wheat plants comparing with un inoculated treatments.

The current investigation aims to study effect of addition of nitrogen rates and bio-fertilization on some soil properties and wheat production at village No. 7. Sahl El- Tina plain located in east of Suez Canal .Bio-fertilization was used in this study to compensate grate additions of mineral nitrogen in newly reclaimed soils, and to minimize harmful effects of pollution resulting from excess nitrogen applications .

MATERIALS AND METHODS

The investigation aimed to study the effect of application mineral nitrogen fertilization at three rates of 28 , 38 and 46 Kg N/fed (urea 46 %) and bio-fertilization *Azospeirillum braselence* NO 40 (salt tolerant PGPR strain) and Aotobacter chroccocum strains, were provide from the soil microbiology, unit of Soil, Water and Environments Res. Instit. Agric. Res. Center Giza, Egypt . Soil samples were collected from surface (0 -30 cm). Soil samples were air dried, passed through a 2 mm sieve. Some physical and chemical properties of the soil were determined according to Black (1985) and show in Table 1.

Table (1): physico-chemical of soil the under study before planting:-

Course sand (%)	Fin sand (%)	Silt (%)	Clay (%)	Texture class	O.M (%)	$CaCO_3$ (%)
17.30	66.7	8.6	9.4	Sandy	0.31	7.9

pH (1:2.5)	EC dSm^{-1}	Cations (meq/l) Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Anins (meq/l) CO^{-}_3	HCO^{-}_3	Cl^{-}	SO^{-}_4
8.21	13.4	9.20	10.91	110	0.52	nil	6.70	87	36.92

Macro elements (mg/kg) N	P	K
47.21	3.4	210

Wheat grains (*Triticum aestivium* c.v Sakha 93) at the rate of 70 kg /fed, were coated with thin layer of the specified of bio-fertilization. The inoculation seed were air dried at room temperature for hour before planting, (El-Sebaey 2006).

The soil and plant analyses were performed as following: particle size distribution was determined by the Pipette method (Piper, 1950) and CaCO3 content was determined by the calcimeter (Black 1965) .Soil organic matter was assayed by the method described by Black (1965). Soil pH was measured using pH meter in soil, water suspension (1:2.5) as described by (Jackson 1967). Electrical conductivity (EC) was measured in soil peast extract (Jackson 1967). Available N was extracted from soil using 2N KCl solution and measured according to the modified Kjeldahel method, (Black, 1965). Available P was extracted by 0.5 N sodium-bicarbonate, and determined calorimetrically according to Olsen's' method (Jackson, 1967). Available K was determined using the Flame-Photometer according to Chapman and Pratt (1961).

Plant samples were taken after harvest, washed with tap water and distilled water and oven dried at 70 C°. Total nitrogen in plant samples was determined according to Jackson (1967), Phosphorus was determined according to Chapman and Pratt (1961) by flame- photometer. All treatments were carried out in split plot design with three replicates for each. The obtained data were statistically analyzed according to Snedecore and Cochran (1979).

RESULTS AND DISSCUSION

Soil salinity (EC) of the studied soil:

Soil salinity package of the chosen experimental pilot units under using El-Salam canal irrigation and treatments fertilization is gave in Table (2). The

data show that the studied three rates from N and bio-fertilizer are generally characterized, from the salinity point of view, by the characters found the semi- arid regions. These characters include the accumulation of salts at the surface zone the soil, mainly due to the higher evaporation process under the dry and hot climate, (Shaban2005). In the case of soil irrigated with El-Salam canal and addition of different N- levels and bio-fertilization led to decrease in EC (dSm^{-1}) values from 13.4 to 9.7 (dSm^{-1}) for soil in initial state and 46 kg N with bio-fertilization treatment respectively, (El-Fayoumy and Ramdan 2002). The corresponding percentage of the soluble salts improvement out were 11.6, 13.2 and 25.2 for soil inoculation 46, 38 and 28 kg N/fed respectively as compares to the soil un inoculated. This soil EC (dS/m) was decreased may be due to deterioration in the in the status where the large and intermediated aggregate of sizes > 0.5 mm diameter as sequence , mean weight diameter and aggregation index decreased due to use bio- fertilization and cause some changes in soil physical and chemical characteristics (Mantr Pukhri(2006). The application of N at different levels and inoculation with micro organisms led to an increase in total porosity, improves soil aggregation and possible moving salt soil under irrigation water (Nasef *et al.* 2004). Also, the soil treatment with inoculation had significant in fluency on all studied EC soil compared with inoculation. The obtained results are in good agreement in Mostafa(2003) , Shaban and Helmy (2006).

Table (2) Chemical properties of soil after wheat harvest:-

Treatments				Cations mq/l				Anions mq/l			
mineral N-kg/fed	N-Bio	pH (1:2.5)	EC (dS/m)	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_3^{-2}
28	0	8.15	12.1	10.2	9.1	101	0.68	nil	5.1	77	38.20
	Bio	8.11	10.7	11.9	6.9	85	0.75	nil	4.3	62	38.25
	Mean		11.4	11.1	8.0	93	0.72	nil	4.7	70	38.23
38	0	8.12	11.4	9.4	11.6	92	0.71	nil	4.9	75	33.81
	Bio	8.07	9.9	12.5	6.4	80	0.87	nil	4.1	59	36.67
	Mean		10.7	11.0	9.0	86	0.79	nil	4.5	67	35.24
46	0	8.10	11.1	8.79	12.9	88	0.70	nil	4.6	66	39.79
	Bio	8.01	8.3	13.1	5.7	63	0.94	nil	3.7	55	24.04
	Mean		9.7	10.9	9.3	76	0.82	nil	4.2	77	31.92
Mean	0	8.12	11.5	9.5	11.2	94	0.70	nil	4.9	73	37.27
	Bio	8.06	9.6	12.5	6.3	76	0.85	nil	4.0	59	32.99
LSD 5%	N	1.06	0.53	0.54	0.52	4.15	0.04	nil	1.26	7.27	6.07
	Bio	0.90	0.43	0.42	0.43	3.40	0.03	nil	1.03	5.93	4.60
	Interaction M X Bio	1.49	0.75	0.76	0.73	5.85	0.06	nil	1.78	10.3	8.56

pH soil :-

Data presented in Table (2) show that addition of N levels and bio-fertilization led to slightly reduce soil pH, where addition bio-fertilizer slightly decreased its values as compared to un inoculated . The relative decrease in soil pH was more pronounced in the soil treated with 46 Kg N/fed with bio-fertilization . The soil of all treatments are characterized by slightly to moderately alkaline conditions (Ayers and Westcot 1985). It is also found that soil pH trend to slightly increase after the wheat harvested. These findings are agreement with these reported by Wahdan *et al.* (1999). The application of bio- fertilizer inoculation and three levels of N – fertilizer (28, 38 and 46 kg N/ fed) gave significant decrease in soil pH specially when nitrogen was applied at rate of 46 kg N/fed with inoculation .Similar results were obtained by Mohamed *et al.* (1998) and El-Fayoumy and Ramadan(2002).

Effect of different N rates and bi-fertilization addition on available N,P and K of studied soil :

Data presented in Table (3) indicted that nitrogen as well as available phosphorus and potassium concentration (mg/ kg soil) were significant increased in soil in all treatments with bio- fertilization (88, 6.4 and 274mg/kg soil) of N,P and K respectively, as compared by un treated. The highest values of N were resulted from the application (urea at rate of 46 kg N/fed with bio-fertilizer).

Table (3): NPK content in soil (mg/kg soil) after maize harvest:-

Treatments		N	P	K
mineral N-kg/fed	N-Bio			
28	0	62	5.2	220
	Bio	67	5.7	254
	Mean	65	5.5	237
38	0	69	5.5	238
	Bio	75	5.9	268
	Mean	72	5.7	253
46	0	79	6.2	249
	Bio	88	6.4	274
	Mean	84	6.3	262
Mean	0	70	5.6	236
	Bio	77	6.0	265
LSD 5%	Mineral	9.14	2.53	13.00
	Bio	7.47	2.07	10.62
	M X Bio	12.9	3.57	18.33

Also, the corresponding relative increases of available N reached 8.1 , 9.8 and 11.4 % at soil treatment with inoculation as compared by un inoculated in the case of 28, 38 and 46 kgN/fed respectively. The values of available N in the soil studied can be arranged in following order as affected by N levels with regardless to incaution treatments:

46 > 38 > 28 Kg N/fed respectively. This result agreement with Rabie (2003) and El-Sebaey (2006).

It is obvious from data presented in Table (3) show that the available phosphorus concentration was the highest in treatments of N and bio-fertilization. The highest value was 6.4 mg /kg soil at soil treated with 46 kg N and bio-fertilization. The corresponding relative increases 9.0, 7.3 and 3.27 % when N was added at 28, 38, and 46 kg N/fed respectively. The values of available P in the studied soil can be arranged in following order as affected with regardless of inoculation treatment: 28 > 38 > 46 Kg N/fed respectively, Abd El-Rasoul *et al.* (2002).

As, shown in Table (3) addition of different N rates and bio-fertilization were significant affected on available potassium in all treatments. The highest values was (274 mg/kg soil) in the case of addition 46 kg N/fed with inoculated treatment. The corresponding relative increases were 15.5, 12.6 and 10.0 % after wheat cultivation for 28, 38 and 46 kg N/fed, respectively.

It is evident from the distribution patterns of soil available Potassium that it could be arranged according its levels in soil as follows:

28 > 38 > 46 kg N with inoculated. Those the results were agreement with Zaghloul (1999) and (Shaban and Helmy 2006).

Some Macro nutrients in wheat crop:

Data presented in Table (4) showed that addition of different nitrogen rates and bio-fertilization increased the concentration of N (%) in (grains and straw) compared with un inoculated treatment . The highest values of concentration of N (%) were 2.94 and 3.89 % in grain and straw respectively. Also, The relative increases of the nitrogen (8.1, 10.4 and 8.1 %) and (4.0, 3.9 and 8.9 %) for grains and straw wheat crop , which mainly depended on the used N rates with bio- fertilization .It could be ranged as follows: 38 > 46 ≥ 28 for grains and 46 > 28 > 38 for straw.

Table (4): Effect of bacterial inoculation and mineral nitrogen on NPK % in wheat grain and straw.

Treatments		N (%)		P (%)		K (%)	
mineral N-kg/fed	N-Bio	Grain	Straw	Grain	Straw	Grain	Straw
28	0	2.35	3.21	0.17	0.21	0.54	2.45
	Bio	2.64	3.34	0.19	0.28	0.65	2.78
	Mean	2.45	3.28	0.18	0.25	0.59	2.61
38	0	2.49	3.32	0.21	0.26	0.61	2.60
	Bio	2.75	3.45	0.22	0.31	0.74	2.94
	Mean	2.62	3.39	0.22	0.29	0.67	2.77
46	0	2.72	3.57	0.24	0.31	0.78	2.88
	Bio	2.94	3.89	0.29	0.39	0.88	3.42
	Mean	2.83	3.73	0.27	0.35	0.83	3.15
Mean	0	2.52	3.37	0.21	0.26	0.64	2.64
	Bio	2.74	3.56	0.23	0.33	0.76	3.05
LSD 5%	Mineral	1.46	2.43	1.75	0.09	0.08	1.38
	Bio	1.19	1.98	0.14	0.08	0.07	1.13
	M X Bio	2.06	3.43	2.47	0.13	0.11	1.95

The different between the effect of N rates and bio- fertilization treatments were also significant. The obtained data are in agreement with Alam *et al.* (2001) and Salama (2006).

Phosphorus content in grains and straw of wheat crop as affected by application of N rates with bio-fertilization are presented in Table (4) Data show that the P content in grains and straw was increased by increasing N rates and bio treatments, compared with un inoculated treatments. P values ranged between 0.17 - 0.29 % and 0.21 – 0.39 for grains and straw, respectively. The lowest and highest level are found at un inoculation state and inoculation respectively. The statistical different between fertilization rates treatments and bio-fertilization treatments on P content in grains and straw were significant. On the other hand, the relative increase of P concentration were (11.7, 4.5 and 20.1 %) for grains and (33.3, 19.2 and 25.8 %) for straw, respectively. The data obtained it the could be arranged according to their P concentration in the following order 46 > 28 > 38 for grains and 28 > 46 > 38 for straw.

This results agreement by (Abd El-Rasoul *et al.* 2002) and Shaban and Helmy (2006) who found that the important role of bacteria for releasing P from super phosphate or other difficult P forms through producing organic and inorganic acids as well as CO_2.

Regarding to the concentration of potassium in the grains and straw of wheat crop, the data presented in Table (4) show that K concentration tends to decrease with increasing N rates with bio-fertilization of the studied saline soils. The highest values of K in grains and straw 0.88 and 3.42 % were found in treated soil by 46 kg N/fed with bio-fertilization respectively. These results in agreement with (El-Sherbieny et al 1999). The relative increases are (20.4 , 21.3 and 12.8 %) for grains and (13.5 , 13.1 and 18.8 %) for straw. It is evident from the distribution patterns of grains and straw concentration K , that it could be arranged according its levels in wheat crop as follows : 38 >28 > 46 for grains and 46 > 28 ≥ 38 kg N/fed for straw respectively. The statistical difference were significant between N levels with bio- fertilization treatments. The obtained data are in harmony with those Panwar (2000) who reported that inoculation with Azospirillum brasilense and Bacillus subtitles significant enhanced mineral content of wheat and biomass production.

Productivity of wheat crop as affected different N rates and bio-fertilization:

Data presented in Table (5) show that dry mater yield was affected by different nitrogen rates and bio-fertilization. However, the dry matter yield of grains and straw ranged between 1.000 – 1.162 and 1.430 – 2.170 ton /fed for grains and straw respectively. For the effect of nitrogen mineral rates and bio fertilization addition, data show that the yield increased significantly of grains and straw were increased by increasing N rates and bio-fertilization

application as compared un inoculation. The corresponding relative increases were 10.0, 20.0 and 1.7 % and 9.9, 11.9 and 14.6 % for grains and straw respectively.

Table (5): Effect of bacterial inoculation and mineral nitrogen on yield and yield component of wheat plant.

Treatments		yield grain (ton/fed)	yield Straw (ton/fed)	Weight grain/plant (gm)	Weight straw /plant (gm)	Weight 1000 grains (gm)	Yield* efficiency (%)
mineral N-kg/fed	N-Bio						
28	0	1.000	1.428	7.32	10.37	25.89	41
	Bio	1.100	1.578	8.94	12.89	27.64	41
	Mean	1.050	1.503	8.13	11.63	26.77	41
38	0	1.189	1.695	9.39	11.19	27.33	41
	Bio	1.430	1.897	9.65	14.42	30.75	43
	Mean	1.310	1.796	9.52	12.81	29.04	42
46	0	1.356	1.893	10.99	13.56	28.17	42
	Bio	1.623	2.169	12.89	17.69	34.91	43
	Mean	1.490	2.031	11.94	15.53	31.54	43
Mean	0	1.182	1.672	9.23	11.71	27.13	41
	Bio	1.384	1.881	10.49	15.00	31.10	42
LSD 5%	Mineral	0.06	0.33	4.04	2.87	5.76	7.9
	Bio	0.05	0.27	3.30	2.35	4.70	6.45
	M X Bio	0.08	0.46	5.69	4.05	8.12	11.14

It is worthy to mention that the superiority of crop yield (grains and straw) at 38 > 46 > 28 kg N/fed for grains and 46 > 38 > 28 kg N /fed for straw , was mainly due to low EC soil which significance affect soil salinity and sodicity during studied different treatment as especially the soil treatment with bio fertilization . This increase is yield is chiefly due to the increase in wheat of grains/ plant. These results are agreement with Shahin, *et al.* (2000) and El-Sebaey (2006). On the other hand from results in Table (5) show that the weight 1000 grain (gm) wheat were significantly increased with different addition treatments inoculation than un inoculation. Finely, the effect of N rate treatment with inoculation on straw and grains (ton/fed) and 1000 grains (gm) of wheat clearly indicted that highest values were obtained when grains were inoculated with 38 kg N/fed. Salem, *et al.* (2004) Nassar *et al.* (2004) and shaban and Helmy (2006)

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تأثير مستويات من التسميد النتروجينى المعدني والحيوي على بعض صفات التربة وإنتاجية القمح في منطقة سهل الطينة

خالد عبده حسن أحمد شعبان – احمد حمادة عبد الرحمن احمد

معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

الملخص العربي

أقيمت تجربة حقلية أثناء موسم ٢٠٠٦ في قرية ٧ بمنطقة سهل الطينة . لدراسة تأثير مستويات مختلفة من التسميد النتروجينى (يوريا ٤٦%) والتسميد الحيوي(اسبيريليم السلالة المقاومة للملوحة وازوتوباكتر) على بعض صفات الاراضى الملحية وصفات محصول القمح.

وكانت مستويات التسميد النتروجينى ٢٨ ، ٣٨ و ٤٦ كجم ن/فدان والتسميد الحيوي .

أضيف التسميد الفوسفاتي (سوبر وسفات ١٥ % فو٢أ٥) والتسميد البوتاسى (كبريتات بوتاسيوم) حسب الكميات الموصى بيها.

أوضحت النتائج أنة حدث نقص طفيف في رقم الحموضة pH التربة و EC (dS/m) التربة وخاصة في المعاملات٣٨ و ٤٦ كجم ن /فدان والمعاملة بالتسميد الحيوي عن غير المعاملة.

زاد النتروجين والفوسفور والبوتاسيوم الميسر في التربة في المعاملات القحة عن غير الملقحة.

زيادة محصول الحبوب والقش زيادة معنوية فى المعاملات الغير ملقحة وكذالك وزن ال١٠٠٠ حبة. زاد تركيز النتروجين والفوسفور والبوتاسيوم فى القش والحبوب فى المعاملات الملقحة عن غير الملقحة. ونجد أن انسب معاملة كانت ٤٦ كجم ن /فدان والملقحة بالبكتريا هي أفضل المعاملات في إنتاجية القمح.