WHEAT YIELD AND NPK UPTAKE AS AFFECTED BY NITROGEN FERTILIZATION IN COMBINATION WITH RHIZOBACTERIN INOCULATION

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ABSTRACT

Two field experiments were performed at the experimental Farm Station of Sids Agricultural Research Station, Agricultural Research Center during the two successive seasons 2003/2004 and 2004/2005 to study the effect of inorganic nitrogen fertilizer applications (0, 25, 50 and 100% of recommended dose (75 kg N/fed) for wheat plants in alluvial clay soil in Beni Suef Governomrate, and seed inoculation with biofertilizer, namely, Rhizobacterin on both grains and straw yields as well as N P K concentrations and uptake by grains and/or straw. The experiment was laid out in a split plot design in randomized complete blocks with four replicates.

Data indicated that both grain and straw yields significantly responded to nitrogen fertilizer additions till the full recommended nitrogen rate, i.e. 75 kg N/fed. Results also, showed that both grain and straw yields significantly increased by seed inoculation with Rhizobacterin inoculant, where the grain yield increases were 9.6 and 8.3% as compared with uninoculated in the two growing seasons, respectively. The best grain and straw yields were obtained when ammonium nitrate (33.5% N) was applied at 75% of recommended rate, i.e. 56.25 kg N/fed in combination with Rhizobacterin inoculation.

It was also found that increasing inorganic nitrogen fertilizer increased both N and K concentrations and uptake in both grains and straw, while P concentrations and uptake did not respond to inorganic nitrogen fertilization. Also, biofertilizer application significantly increased nitrogen concentration in grains and potassium concentrations in grains and straw. Moreover, nitrogen and potassium uptake in grains and/or straw were significantly affected by Rhizobacterin inoculation. On the other hand nitrogen concentration in straw as well as phosphorus concentration in grains or straw and its uptake in straw were not affected by biofertilizer treatments. The combination between inorganic nitrogen and Rhizobacterin inoculation exert the same trend of the effect of biofertilization on NPK concentration and uptake, where, in general the highest values of NPK concentration and uptake were produced by wheat plants fertilized with full recommended nitrogen rate (75 kg N/fed) or the plants inoculated with bacterial Rhizobacterin inoculant and received three fourth of recommended nitrogen rate, i.e. 56.25 kg/fed.

It could be concluded that 75% from recommended nitrogen level combined with seed inoculation by Rhizobacterin satisfied the demands of plant nutrition and the optimum yield production, avoided excessive fertilizer applications and accordingly, reduced the costs of chemical fertilizer applications and environmental pollutions.

Key words: Wheat, Yield, NPK, Nitrogen fertilization and Rhizobacterin inoculation

INTRODUCTION

Agricultural producation in Egypt mainly depends on chemical fertilizers and the rates of their consumption, per unit area are more than the averages of the whole world. However, because of shortages in some fertilizer supplies, and the current cost of energy used in their production, the cost of fertilizers has risen tremendously and will continue rise. In addition, the efficiency of nitrogen fertilizers use in Egypt is low due to nitrate leaching and NH3 volatilization. In view of the economical and environmental problems of using chemical fertilizers, utilization of biofertilizers would not only result in increasing soil fertility and crop production through its additional nutrient supply, but would also help in solving sanitary and environmental problems, as well as would save foreign currency for Egypt.

Generally, there is agreement, that of all the nutrients added to soil, nitrogen application has had the most important effects in increasing wheat production. Numerous investigators stated that increasing nitrogen fertilizer increases both wheat grain and straw yield as well as N, P and K uptake by grains or straw **(Gegraiel, 1995; Radwan and El-Nimr, Hanyiat, 1996; Mahmoud and Ismail, 1997; Metwally, 2000; Ahmed 2001 and Ismail *et al,* 2006).**

Several investigators stated that bio-fertilization with associative N_2-fixers gave appreciable increases in grain and straw yields as well as N P K uptake **(Gegraiel, 1995; El-Sersawy *et al,* 1997; El-Mancy, 1998; Metwally, 2000; Ahmed, 2001 and Shawer, 2003).** Moreover, **Gegraiel (1995), Mervat and Dahdoh (1997), Sobh *et al,* (2000) and Tantaway, Eman (2001)** reported that biofertilization of wheat plant by using rhizobacteria inoculants can decrease the recommended inorganic nitrogen fertilizers to obtain the maximum production.

The present investigation was initiated to study the effect of biofertilization and level of nitrogen fertilizer on grain and straw yields as well as N P K uptake by wheat plants.

MATERIALS AND METHODS

The present investigation was conducted at the experimental Farm Station of Sids Agricultural Research Station, Agricultural Research Center during the two successive seasons (2003/2004 and 2004/2005) on wheat (*Triticum aestivum* L.), Sids 1 cultivar.

Treatments included 4 nitrogen applications (zero, 25%,75% and 100% of recommended N rate for wheat crop in alluvial clay soil in Beni Suef Governomrate, i.e. 0, 18.75, 37.50, 56.25 and 75 kgN/fed as ammonium nitrate 33.5% N in combination with inoculation with the biofertilizer Rhizobacterin (an inoculant for all crops in Egypt contaning nitrogen fixing bacteria, Azotobacter chroococcum and Azospirillum brasilense), provided by the General Organization for Agriculture Equalization, Ministry of Agriculture and Land Reclamation, Egypt **(Abou El-Naga, 1993).**

The number of combinations were 10 treatments distributed in split plot design with four replicates . Nitrogen applications were allocated at random in the main plots, while bio-fertilization treatments (with and without inoculation) were randomly distributed in the sub plots.

Inoculation was performed by coating wheat grains with the Rhizobacterin inoculant using a sticking substance (Arabic gum 5%) just

before sowing (at 15th and 20nd November in the two growing seasons, respectively). A composite soil sample was collected before planting for each season to identify some soil physical and chemical properties of the studied experimental field according to official methods described by **Black (1965)** as presented in Table (1). Other practices were carried out as recommended.

At harvest, yields of both grains and straw were recorded as ardab and ton/fed, respectively. N, P and K concentrations were determined in grains and straw samples on dry weight basis according to **Black (1965)** and then N, P and K uptake in grain and/or straw was calculated. All collected data were statistically analyzed according to the procedure described by **Snedcor and Cochran (1980).**

Table 1. Some physical and chemical properties of the experimental Soil.

Soil properties	First season	Second season
Particle size distribution %		
sand	17.5	18.2
Silt	27.5	28.1
Clay	55.0	53.7
Texture grade	Clay	Clay
pH(1:2.5 soil water suspension)	7.8	7.9
EC (dSm^{-1} at 25 ^{o}C in soil paste)	0.30	0.28
$CaCO_3$ %	2.2	2.5
Organic matter ,%	1.8	1.6
Available N ugg^{-1} (extracted by 2 N KCl)		
Available P ugg^{-1} (extracted by0.5 N $NaHCO_3$ at pH 8.5)	20.5 18.2	21.6 19.6
Available K ugg^{-1} (extracted by NH_4OAc	210	190

RESULTS AND DISCUSSION

Wheat grain and straw yields:

Data in Table (2) indicate that both grain and straw yields significantly increased as nitrogen rates were increased from zero to 75 kg N/fed (the recommended rate for wheat production in alluvial clay soil in Beni Suef Governomrate). Wheat fertilized plants with the recommended rate (75 kg N/fed) scored the highest values of both grain and straw yields, while the lowest values were recorded in the unfertilized plants. This may be due to the influence of nitrogen fertilization in increasing the formation of amino acids, growth hormones, proteins and other roles which in turn acted positively as reported by **Ahmed (2001)** for cell division and enlargement and producing new tissues, organs and differentiated to tillers, internodes and blades as well as increasing number of spike lets per spikes, number of grains per spike, weight of spikes and weight of 100-grain, consequently increased grain and straw yields. The results are also in a good agreement with several workers (**Mahmoud and Ismail, 1997; Metwally,2000and Ismail *et al*, 2006).**

Table 2. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on wheat grain and straw yields.

Treatments		Grain yield (ardab**/fed)		Straw yield (ton/fed)	
N levels (kg/fed)	Bio-fertilizer inoculation*	1st Season	2nd Season	1st Season	2nd Season
0.00	-	13.96	11.73	4.57	4.65
	+	16.26	14.04	4.54	4.87
Mean		**15.11**	**12.89**	**4.53**	**4.76**
18.75	-	18.75	17.68	5.18	5.12
	+	19.91	19.46	5.30	5.33
Mean		**19.33**	**18.58**	**5.24**	**5.23**
37.50	-	19.11	19.64	5.50	5.33
	+	22.04	20.80	5.56	5.39
Mean		**20.58**	**20.22**	**5.53**	**5.36**
56.25	-	21.72	22.38	5.69	5.56
	+	24.85	25.22	5.91	5.72
Mean		**23.29**	**23.80**	**5.80**	**5.64**
75.00	-	24.94	25.21	5.98	5.81
	+	24.96	25.16	5.99	5.79
Mean		**24.95**	**25.19**	**5.99**	**5.80**
Mean of Rhizobacterin inoculation	-	**19.70**	**19.33**	**5.37**	**5.29**
	+	**21.60**	**20.94**	**5.46**	**5.42**
L.S.D at 0.05					
A (nitrogen levels)		**1.31**	**1.13**	**0.24**	**0.39**
B (Rhizobacterin inoculation)		**0.97**	**0.91**	**0.06**	**0.10**
AxB		**1.69**	**1.59**	**0.31**	**0.43**

*- means without inoculation
+ means with inoculation
** one ardab = 150 kg wheat grains

With regard to the effect of biofertilizerapplication on both grain and straw yields of wheat plant, data reveal that Rhizobacterin inoculation significantly increased both grain and straw yields in the two growing seasons. The relative increases in grain yield were 9.6 and 8.3% over without biofertilization treatments for the two seasons, respectively. The same trend was observed for straw yield. The principle mechanism by which biofertilizers could benefit the plant growth can go trough: a- fixing molecular nitrogen and its transfer to plant as direct effect, b- production of plant growth hormones (Auxins, GAS and CKS) by bacteria which could release in the root media and affect its growth and extension, the resultant could be more absorption of nutrients which reflects on more growth activity, nitrogenous compounds assimilation, forming more growth substances, more cell division and enlargement, more forming of tissues and organs and grains and straw production **(El-Khawas, 1981).** Similar results were obtained by **Metwally (2000) and Shawer (2003).**

With regard to the combination of Rhizobacterin inoculation with N-fertilizer, data reveal that the combination of Rhizobacterin with NH_4NO_3 application up to the rate 56.25kg N/fed (75%of recommended rate)

significantly increased both grain and straw yields. Further increase of inorganic fertilizer up to 100% of recommended rate with or without biofertilizers yielded grain and straw yields almost similar to those yielded upon application of 75% of recommended rate with biofertilization. It is worthy to mention that the most effective fertilization treatment was that composed of three fourths of recommended rate (56.25 kg/fed) in combination with Rhizobacterin inoculation.. These results are in close agreement with those of **Sobh *et al*, (2000) and Tantaway, Eman (2001).**

N P K concentrations in wheat grains and straw:

As shown in Table (3, 4 and 5) raising nitrogen addition to wheat plants up to 75 kgN/fed had positive effect on both nitrogen and potassium percentage in grains or straw of wheat plants in the two growing seasons, while phosphorus percentage was not affected by increasing nitrogen dose. The increments of nitrogen percentages due to increasing nitrogen level could be attributed to increasing available nitrogen in the root zone due to fertilizer application which may caused more nitrogen absorption rate than that of dry matter accumulation by plants in grains or straw. **Kanany (1996)** showed that increasing nitrogen fertilization leads to highly significant increases in nitrogen concentration in wheat grains and straw at maturity stage. **El-Awag *et al*, (1996)** stated that potassium percentage in grains or straw increases by increasing nitrogen levels.

It could be noticed from the obtained data that the concentration of nitrogen and potassium in wheat grains as well as potassium percentage in straw had been significantly increased upon inoculation with Rhizobacterin as compared to non inoculated plants. While, nitrogen percentage in straw and phosphorus percentage in both grains and straw were not affected by inoculant addition in the two growing seasons. The beneficial effect of bacterial inoculation on nitrogen concentration in wheat grains and potassium percentage in grains and straw may be attributed to the promoting effect of the free N2-fixers. These results are in accordance of those obtained by **El-Mancy (1998).**

Regarding the combination between mineral N and biofertilization, data in Table 3,4,5 reveal increases in the percentages of nitrogen in grains and potassium in grains and straw of wheat plants as nitrogen fertilizer rates were increased together with Rhizobacterin inoculation, while the concentration of nitrogen in straw and phosphorus in both grains and straw were not affected. Generally, higher percentages were obtained by using Rhizobacterin with 75 kg N/fed. Moreover, it is evident from the obtained results that, the N and K percentages in plants fertilized with 75% of recommended field rate in combination with bacterial inoculant was more or less similar to that of the N-fertilized plants with 100% of recommended field rate (75 kg N/fed) alone. Similar results were obtained by **Gebraiel (1995).**

Table 3. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on nitrogen concentration (%) in grains and straw.

Treatments		N-concentration in grains		N-concentration in straw	
N levels (kg/fed)	Rhizobacterin inoculation*	1st Season	2nd Season	1st Season	2nd Season
0.00	-	2.04	1.68	0.54	0.56
	+	2.20	1.71	0.55	0.55
Mean		**2.12**	**1.70**	**0.55**	**0.56**
18.75	-	2.19	1.77	0.62	0.63
	+	2.21	1.81	0.62	0.62
Mean		**2.20**	**1.79**	**0.62**	**0.63**
37.75	-	2.28	1.91	0.69	0.69
	+	2.40	1.96	0.68	0.71
Mean		**2.34**	**1.94**	**0.69**	**0.70**
56.25	-	2.46	2.09	0.72	0.73
	+	2.61	2.25	0.80	0.78
Mean		**2.54**	**2.17**	**0.74**	**0.76**
75.00	-	2.62	2.25	0.81	0.79
	+	2.61	2.26	0.81	0.78
Mean		**2.62**	**2.26**	**0.81**	**0.79**
Mean of bio-fertilizer	-	**2.32**	**1.94**	**0.68**	**0.68**
	+	**2.41**	**2.00**	**0.69**	**0.69**
L.S.D at 0.05					
A (nitrogen levels)		**0.28**	**0.18**	**0.10**	**0.13**
B (Rhizobacterin inoculation)		**0.06**	**0.03**	**N.S**	**N.S**
A xB		**0.39**	**0.26**	**N.S**	**N.S**

*- means without inoculation + means with inoculation

Table 4. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on phosphorus concentration (%) in grains and straw.

Treatments		P-concentration in grains		P-concentration in straw	
N levels (kg/fed)	Rhizobacterin inoculation*	1st Season	2nd Season	1st Season	2nd Season
0.00	-	0.31	0.33	0.03	0.04
	+	0.31	0.34	0.03	0.04
Mean		**0.31**	**0.34**	**0.03**	**0.04**
18.75	-	0.30	0.34	0.04	0.05
	+	0.32	0.34	0.03	0.04
Mean		**0.31**	**0.34**	**0.04**	**0.05**
37.75	-	0.32	0.33	0.04	0.04
	+	0.31	0.34	0.04	0.05
Mean		**0.32**	**0.34**	**0.04**	**0.05**
56.25	-	0.32	0.33	0.04	0.05
	+	0.31	0.34	0.03	0.05
Mean		**0.32**	**0.34**	**0.04**	**0.05**
75.00	-	0.31	0.33	0.03	0.04
	+	0.30	0.33	0.04	0.05
Mean		**0.31**	**0.33**	**0.04**	**0.05**
Mean of bio-fertilizer	-	**0.31**	**0.33**	**0.04**	**0.04**
	+	**0.31**	**0.34**	**0.03**	**0.05**
L.S.D at 0.05					
A (nitrogen levels)		**N.S**	**N.S**	**N.S**	**N.S**
B (Rhizobacterin inoculation)		**N.S**	**N.S**	**N.S**	**N.S**
A xB		**N.S**	**N.S**	**N.S**	**N.S**

*- means without inoculation + means with inoculation

Table 5. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on potassium concentration (%) in grains and straw.

Treatments		K-concentration in grains		K-concentration in straw	
Nitrogen levels (kg/fed)	Rhizobacterin inoculation*	1st Season	2nd Season	1st Season	2nd Season
0.00	-	0.60	0.58	1.94	2.64
	+	0.60	0.63	2.33	2.73
Mean		**0.60**	**0.61**	**2.14**	**2.70**
18.75	-	0.70	0.67	2.57	2.83
	+	0.71	0.71	2.63	2.89
Mean		**0.71**	**0.69**	**2.60**	**2.86**
37.75	-	0.72	0.71	2.64	2.91
	+	0.73	0.73	2.81	3.11
Mean		**0.73**	**0.72**	**2.73**	**3.01**
56.25	-	0.78	0.79	3.00	3.13
	+	0.82	0.82	3.24	3.33
Mean		**0.80**	**0.81**	**3.12**	**3.23**
75.00	-	0.81	0.82	3.23	3.35
	+	0.82	0.83	3.26	3.34
Mean		**0.82**	**0.83**	**3.25**	**3.35**
Mean of bio-fertilizer	-	**0.72**	**0.71**	**2.68**	**2.97**
	+	**0.74**	**0.74**	**2.85**	**3.08**
L.S.D at 0.05					
A (nitrogen levels)		**0.07**	**0.09**	**0.37**	**0.21**
B (Rhizobacterin inoculation)		**0.01**	**0.02**	**0.01**	**0.06**
A xB		**0.16**	**0.22**	**0.43**	**0.61**

*- means without inoculation + means with inoculation

N P K total uptake:

Data presented in Tables (6, 7 and 8) concerning N P K uptake in grain and/or straw again confirmed the beneficial effect of performing mineral nitrogen or bio fertilization previously obtained with grain and straw yield (Table, 2), except with P uptake due to Rhizobacterin inoculation. The obtained data reveal that increasing nitrogen levels from 0 to 75 kg N/fed significantly increased N P K uptake in grains and/or straw. The obtained values by grains were higher than by straw, except for K uptake which shows reverse trend. The increases in percentages of total N, P and K uptake due to increasing nitrogen level from 0 to 75 kg/fed were 102.0, 88.5 and 105.2%, respectively in the first season. The same trends were obtained in the second season. This increments could be due to the effect of increasing nitrogen levels on grain and straw yield (Table, 2). Similar results were obtained by many workers such as **El-Sersawy *et al* (1997), Metwally (2000), Ahmed (2001), Shawer (2003) and Ismail *et al* (2006).**

Table 6. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on nitrogen uptake (kg/fed) in grains and/or straw.

Treatments		1st Season			2nd Season		
N levels (kg/fed)	Rhizobacterin inoculation*	Grains	Straw	Total	Grains	Straw	Total
0.00	-	41.96	25.18	65.32	28.61	25.16	54.81
	+	52.65	25.89	78.61	37.31	27.36	64.11
Mean		**47.31**	**25.54**	**71.99**	**33.47**	**26.26**	**59.46**
18.75	-	60.98	31.82	92.03	47.36	32.91	79.61
	+	67.11	33.35	100.91	52.31	33.62	85.03
Mean		**64.04**	**32.59**	**96.47**	**49.84**	**33.27**	**82.32**
37.75	-	65.19	38.19	104.05	57.36	37.91	95.61
	+	80.03	38.95	118.61	62.38	38.65	101.36
Mean		**72.61**	**38.57**	**111.33**	**59.87**	**38.28**	**98.49**
56.25	-	81.13	40.61	120.91	71.10	40.81	111.62
	+	97.21	46.13	143.81	84.78	44.91	128.35
Mean		**89.17**	**43.37**	**132.36**	**77.94**	**42.86**	**119.99**
75.00	-	98.13	48.62	145.19	84.09	45.11	129.31
	+	98.19	48.71	145.62	84.42	45.36	130.02
Mean		**98.16**	**48.67**	**145.41**	**84.26**	**45.24**	**129.67**
Mean of bio-fertilizer	-	**69.48**	**36.88**	**105.50**	**57.90**	**36.38**	**94.19**
	+	**79.04**	**38.61**	**117.52**	**64.24**	**37.98**	**101.77**
L.S.D at 0.05							
A (nitrogen levels)		**12.53**	**4.28**	**14.21**	**5.31**	**5.60**	**7.20**
B (Rhizobacterin inoculation)		**6.11**	**1.03**	**8.61**	**3.12**	**1.11**	**4.96**
A xB		**16.19**	**5.16**	**19.52**	**6.09**	**5.98**	**9.12**

*- means without inoculation + means with inoculation

Regarding the influence of Rhizobacterin inoculation, the obtained results indicate that there are significant increases in N, P and K uptake in grains and/or straw of wheat plants due to inoculation as compared to uninoculated plants, except phosphorus uptake by straw in both seasons where no remarkable differences were detected. The highest values of nutrients uptake were observed in grains than in straw, except potassium uptake in grains which was relatively lower than in straw. Similar trends were obtained by **Shawer (2003).** Inoculation of wheat seeds by Rhizobacterin increased the total uptake of N, P and K in grains by about 11.4, 10.1 and 7.7%, respectively in the first season as compared with those uninoculated. The corresponding values for the second season were 8.0, 8.0 and 7.4%. The positive effect of bacterial inoculation upon nutrient uptake could be attributed to the high efficiency of bacteria present in Rhizobacterin to fix atmospheric nitrogen and/or the producation of some biologically active substances, e.g. IAA, ALA, gibberellin and cytokinine-like substances. These substances greatly help in increasing the root biomass and thus indirectly help in greater absorption of nutrients from surrounding environment **(El-Mancy, 1998).** Also, such increments could be attributed to the effect of biofertilization on both grains and straw yields (Table, 2), since thenutrient uptake is derived from multiplying yield by nutrient concentration. These results agree with those obtained by **Mervat and Dahdoh (1997), El- Mancy (1998) and Shawer (2003).**

Table 7. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on phosphorus uptake (kg/fed) in grains and/or straw.

Treatments		1st Season			2nd Season		
N levels (kg/fed)	Rhizobacterin inoculation*	Grains	Straw	Total	Grains	Straw	Total
0.00	-	6.29	1.39	7.11	5.85	1.83	7.31
	+	7.66	1.42	8.31	7.09	1.96	8.12
Mean		**6.98**	**1.41**	**7.30**	**6.47**	**1.90**	**7.71**
18.75	-	8.91	1.96	9.21	9.31	2.27	11.71
	+	9.32	1.62	11.09	9.98	2.29	12.13
Mean		**9.12**	**1.79**	**10.15**	**9.65**	**2.28**	**11.92**
37.75	-	9.31	2.21	12.01	9.79	2.23	12.31
	+	10.63	2.90	12.81	11.03	2.71	13.59
Mean		**9.97**	**2.56**	**12.41**	**10.41**	**2.47**	**12.95**
56.25	-	10.13	2.28	12.13	11.61	2.82	13.01
	+	11.69	1.89	13.61	12.52	2.91	15.10
Mean		**10.09**	**2.09**	**12.87**	**12.07**	**2.87**	**14.06**
75.00	-	11.63	1.85	13.71	12.56	2.41	15.01
	+	11.51	2.31	13.80	12.51	2.90	15.16
Mean		**11.57**	**2.08**	**13.76**	**12.54**	**2.66**	**15.09**
Mean of bio-fertilizer	-	**9.25**	**1.94**	**10.83**	**9.82**	**2.31**	**11.87**
	+	**10.16**	**2.03**	**11.92**	**10.63**	**2.55**	**12.82**
L.S.D at 0.05							
A (nitrogen levels)		**2.18**	**0.25**	**2.28**	**1.83**	**0.43**	**1.88**
B (Rhizobacterin inoculation)		**0.62**	**N.S**	**0.69**	**0.51**	**N.S**	**0.56**
A xB		**2.36**	**N.S**	**2.81**	**2.15**	**N.S**	**2.26**

*- means without inoculation + means with inoculation

As for the combination of inorganic nitrogen fertilizer and biofertilizer, the results also reveal that the combination of Rhizobacterin inoculation with N fertilizer up to 56.25 kg N /fed (75% of recommended rate) gave more or less N P K uptake values similar to that of the plants received full recommended N dose (75 kg/fed), except for P uptake by straw which was not affect by the combination between mineral and bio-fertilizer in the two seasons. In general, the highest values of N P K uptake were obtained in wheat plants inoculated with Rhizobacterin and supplied with 100 or 75% of recommended rate. Similar results were also found by **Mancy (1998) and Shawer (2003).**

Based on the results of the present work it could be concluded that the use of Rhizobacterin inoculant as a biofertilizer could save about 25% of recommended nitrogen rate to obtain the maximum yields of wheat grains and straw.

Table 8. Effect of nitrogen fertilization rate and Rhizobacterin inoculation on potassium uptake (kg/fed) in grains and/or straw.

Treatments		1st Season			2nd Season		
N levels (kg/fed)	Rhizobacterin inoculation*	Grains	Straw	Total	Grains	Straw	Total
0.00	-	12.11	87.12	99.13	10.36	120.19	130.13
	+	14.56	105.01	118.61	13.61	132.61	146.33
Mean		**13.34**	**96.07**	**108.87**	**11.99**	**126.40**	**138.23**
18.75	-	19.52	131.12	151.63	17.92	143.19	160.91
	+	21.29	138.61	160.61	20.86	153.12	174.62
Mean		**20.41**	**134.87**	**156.12**	**19.39**	**148.16**	**167.77**
37.75	-	20.89	143.19	164.01	21.21	156.71	177.92
	+	24.19	156.61	171.81	22.63	168.21	191.17
Mean		**22.54**	**149.90**	**167.91**	**21.92**	**162.46**	**184.55**
56.25	-	25.91	169.81	195.21	25.96	175.12	201.18
	+	31.02	190.12	222.37	31.26	191.16	224.61
Mean		**28.47**	**179.97**	**208.79**	**28.61**	**183.14**	**212.90**
75.00	-	30.98	192.01	223.12	31.31	193.72	225.21
	+	30.92	193.61	223.67	31.29	192.68	224.96
Mean		**30.95**	**192.81**	**223.40**	**31.30**	**193.32**	**225.09**
Mean of bio-fertilizer	-	**21.82**	**144.65**	**166.62**	**21.35**	**157.79**	**179.07**
	+	**24.40**	**156.79**	**179.41**	**23.93**	**167.56**	**192.34**
L.S.D at 0.05							
A (nitrogen levels)		**3.28**	**19.60**	**20.61**	**2.49**	**17.36**	**19.06**
B (Rhizobacterin inoculation)		**1.18**	**6.21**	**8.65**	**1.01**	**6.03**	**8.12**
A xB		**3.96**	**22.76**	**25.17**	**2.86**	**20.19**	**26.65**

*- means without inoculation + means with inoculation

REFERENCES

Abou El-Naga, S. H. (1993). Production of Biofertilizers by General Organization for Agriculture Equalization Fund in Egypt. (GOAEF) P.P. 508-514.

Ahmed, A. A. (2001). Response of wheat plants to nitrogen and biological fertilization under conditions of North West Coast of Egypt. M. Sc. Thesis, Fac. of Agric., Ain Shams Univ. Egypt.

Black, C. A. (1965). Methods of Soil Analysis (Part 2). American Society of Agronomy, Inc. Publisher, Madison, Wisconsin, USA.

El-Awag, T. L.; Hanna, A. M. and El-Naggar, L. M. (1996). Influence of mineral and organic nitrogen fertilization on wheat production and some soil physical properties. J. Agric. Sci. Mansoura Univ., 21(4): 1491-1500.

El-Khawas, H. M. (1981). Ecological studies on a symbiotic N2-fixing bacteria in soil and rhizosphere of certain plants. M. Sc. Thesis, Fac. of Agric., Cairo Univ.,Egypt.

El-Mancy, M. H. (1998). Wheat growth and some nutrient contents as affected by bacterial inoculation under graded levels of N and P. J. Agric Sci. Mansoura Univ., 23(8): 4059-4071.

El-Sersawy, M. M.; Bouthina, F. A.; Khalil, K. W. and Awadalla, S. Y. (1997). Interaction between organic manure mixtures applied as N-level and biofertilization on calcareous soil properties and wheat production in Wadi Sudr, South Sinai, Egypt. J. Soil Sci., 37(3): 367-397.

Gebraiel, M.Y. (1995). The interaction effect of biofertilizers and mineral fertilizers on growth, yield and biocontents of some economic crops. Ph.D. Thesis, Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

Ismail, S. A.; Morsy, M. A.; Omran, A. A. and Foaad, M. M. (2006). Wheat grain and straw yields, grain quality and some nutrients uptake as affected by nitrogen sources and levels under zinc application. The Second Conference On Farm Integrated Pest Management, 16-18 Jan., 2006, Fayoum., Egypt.

Kanany, R. E. E. (1996). Effect of irrigation and fertilization on crop yield and nutrient uptake. Ph.D. Thesis, Fac. of Agric., Mansoura Univ., Egypt.

Mahmoud, S. Kh. and Ismail, S. A. (1997). Response of long spike wheat varieties to high nitrogen fertilization rates. Fayoum J. Agric. Res. & Dev., 11(2): 169-182.

Mervat, A. T. A. and Dahdoh, M. S. A. (1997). Effect of inoculation with plant-growth promoting rhizobacteria (PGPR) on yield and uptake of nutrients by wheat grown on sandy soil of Egypt. J. Soil Sci., 37(4): 467-484.

Metwally, S. G. (2000). Fertilizer use efficiency of wheat as affected by microbial inoculation and soil conditions. Ph.D. Thesis, Fac. of Agric. Mansoura Univ., Egypt.

Radwan, F. I. and El-Nimr, Hanyiat, E. (1996). Effect of soil nitrogen application and biofertilization on yield and yield components of wheat. Adv. Agric. Res., 1(1): 45-55.

Shawer, S. S. (2003). Crop response to different fertilization programs in newly reclaimed soil. M. Sc. Thesis. Fac. of Agric., Al-Azhar Univ., Egypt.

Snedcor, G. W. and Cochran, W. G. (1980). Statistical Methods, 7th Ed. Iowa State Univ., Press, Iowa, USA.

Sobh, M. M.; Genaidy, S. and Hegazy, M. (2000). Comparative studies on mineral and biofertilization for some main field crops in Northern Delta soils. Zagazig J. Agric. Res., 27(1): 171-179.

Tantaway, Eman, A. A. (2001). Response of some field crops to inoculation with nitrogen fixing bacteria under different soil conditions. Ph. D. Thesis, Fac. of Agric. Cairo Univ. Egypt.

تأثير التسميد النيتروجيني والتلقيح بالريزوباكترين على محصول القمح و محتوى الحبوب والقش من النيتروجين والفوسفور والبوتاسيوم

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أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة البحوث الزراعية بسدس بمركز البحوث الزراعية خلال موسمي النمو ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/ ٢٠٠٥ لدراسة تأثير مستويات مختلفة من التسميد النيتروجين المعدني (٠ و ٢٥ و ٥٠ و ٧٥ و ١٠٠% من الكمية الموصي بها لانتاج القمح في المنطقة وهي ٧٥ كجم نيتروجين للفدان) وكذلك التلقيح البكتيري بلقاح الريزوباكتيرين علي محصول الحبوب والقش وكذلك محتوي وامتصاص الحبوب والقش من عناصر النيتروجين والفوسفور والقش باستخدام القطع المنشقة في قطاعات كاملة العشوائية وكررت كل معاملة أربع مرات.

وقد أظهرت النتائج استجابة كل من محصول الحبوب والقش معنويا لزيادة التسميد المعدني حتى المستوي الموصي به وهو ٧٥ كجم نيتروجين للفدان. وكذلك ازداد محصول كل من الحبوب والقش بالتلقيح البكتيري حيث وصلت الزيادة في محصول الحبوب إلى ٩,٦ و ٨,٣% للنباتات الملقحة مقارنة بالتي لم تلقح في الموسمين علي التوالي. كما أوضحت النتائج أن افضل محصول للحبوب والقش أمكن الحصول عليه عند استخدام التسميد المعدني (نترات أمونيوم ٣٣,٥%) عند مستوي ٧٥% من الموصي به (٥٦,٢٥ كجم ن/فدان) مضافا مع التسميد الحيوي.

أظهرت النتائج أن زيادة التسميد النيتروجيني المعدني أدى إلى زيادة في كل من محتوي وامتصاص النيتروجين والبوتاسيوم في الحبوب والقش بينما لم يتأثر محتوي وامتصاص الفوسفور بالتسميد النيتروجيني. كما أدت إضافة السماد الحيوي إلى زيادة معنوية في محتوي النيتروجين في الحبوب ومحتوي البوتاسيوم في كل من الحبوب والقش وكذلك فان امتصاص النيتروجين والبوتاسيوم في الحبوب والقش قد تأثر معنويا بالتلقيح بلقاح الريزوباكتيرين. ومن ناحية أخري فان محتوي النيتروجين في القش وكذلك محتوي الفوسفور في الحبوب أو القش وكذلك امتصاصه في القش لم يتأثر بالتسميد الحيوي. كما أظهرت إضافة التسميد المعدني مع التلقيح الحيوي نفس اتجاه تأثير أضافه الأسمدة الحيوية فقط علي محتوي وامتصاص عناصر النيتروجين والفوسفور والبوتاسيوم. وبصفة عامة كان اعلي القيم لمحتوي وامتصاص هذه العناصر للنباتات التي سمدت بالكمية الموصي بها من التسميد النيتروجيني المعدني فقط أو تلك التي سمدت ب ٧٥% من الكمية الموصي بها(٥٦,٢٥ كجم نيتروجين/فدان) مع استخدام اللقاح البكتيري.

وهكذا يمكن استنتاج أن معدل ٧٥% من كمية السماد النيتروجيني المعدني (حوالي ٥٦,٢٥ كجم نيتروجين فدان) مع التلقيح البكتيري بالسماد الحيوي ريزوباكتيرين تكفي متطلبات تغذية محصول القمح لانتاج محصول امثل مع تجنب الإضافات الزائدة من الأسمدة الكيمائية مما تؤدي إلى تقليل التكاليف الناجم عن إضافة معدلات عالية من تلك الأسمدة وكذلك تقليل التلوث البيئي.