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IMPROVING WHEAT PRODUCTIVITY BY BIO-NITROGEN FERTILIZATION UNDER NEWLY PLANTED SANDY SOILS.

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ABSTRACT

The present investigation was carried out in sandy soil at the Experimental Farm of El-Boustan, Faculty of Agriculture, Damanhour, Alexandria University, during 2003/2004 and 2004/2005 growing seasons. This investigation was designed to evaluate the performance and production of two wheat cultivars i.e.,Giza 164 and Sakha 69 as well as the effect of three bio-nitrogen fertilization treatments (untreated, Nitrobin and Microbin) and five rates of chemical nitrogen fertilizer doses (49, 98, 147, 196 and 245 Kg N/ha) on these cultivars of wheat.

The following results were recorded:

- Giza 164 cultivar significantly surpassed Sakha 69 cultivar in all studied traits i.e., grain yield (ton/ha), straw yield (ton/ha), biological yield (ton/ha), harvest index (%), number of spikes/m^2, spike length, number of kernels/spike, 1000- kernel weight and plant height, in both seasons.
- As for bio-nitrogen fertilization, all studied traits, except harvest index, highly significantly increased by inoculation of wheat grains either by Nitrobin or Microbin compared with uninoculated ones, in both seasons. Microbin biofertilizer insignificantly increased all studied traits – except harvest index- compared with Nitrobin, in both seasons.
- Increasing doses of chemical nitrogen fertilization showed significant effect on all studied traits– except harvest index- in both seasons, up to 196 Kg N/ha whereas differences between of 196 and 245 Kg N/ha were insignificant.
- There were highly significant interaction between bio-nitrogen fertilization treatments and doses of chemical nitrogen fertilizer for all studied traits, except harvest index.
- The present study recommended sowing inoculated grains of Giza 164 wheat cultivar by Microbin plus of 196 Kg N/ha of chemical nitrogen fertilizer to produce good production of grain yield and decreasing environmental pollution by decreasing chemical nitrogen fertilizers by 20 % under newly reclaimed sandy soil conditions.

INTRODUCTION

Wheat is one of the most important cereal crops in the world as well as in Egypt. The local production represents about 58 - 63 % of the consumption (Sorour *et al.*, 2004). Therefore, attempts to increase wheat production are of most importance. Such attempts could be partially achieved through horizontal expansion at new reclaimed areas. Such soils are very poor and deficient in nutrients. Nitrogen is limited element for wheat production. Many studies revealed that the application of chemical N fertilizers exhibited much significance for maintaining high wheat yield (Saleh, 2001; Ahmed, Seham, 2002; Ali *et al.*, 2004 and Abel-Hamed, 2005). However, the chemical N fertilizers are not only a costly input, but also a polluting to agroecosystem. Sustainable agroecosystem is essential for agricultural development. Protection of the environment with the sustainability of the soil and agroecosystem should gain as much concern as maintains of high yield. Therefore, there is a current trend, at the local as well as the global scale, to reduce the use of chemical N fertilizers with keeping high crop productivity at the same time (El-Aggory *et al.*, 1996). On the way to achieve such valuable goal, bio-N fertilizers drew the attention as partial good alternative to substitute the chemical N fertilizers through serving as a safe effective, where, supply part of plants N requirement as about 25 %, increases the availability of nutrient elements, reduces the environmental pollution, economical source of nitrogen and improves the potential yield (Bohiool *et al.*, 1992 and Saber, 1993;). Bio-fertilizers including microbial inoculations are capable of enhancing soil fertility, increase crop's fertilizer use efficiency consequently crop growth and yield (El-Naggar *et al.*, 2005).

Few microorganisms able to fix N, the free-living bacteria i. e., *Azotobacter* and *Azospirillum* with high capacity in fixing element N non-symbiotically (Rao, 1982; and Kennedy and Tchan, 1992). Several studies reported increase in non-legumes and its components using the inoculation with *Azotobacter* and/or *Azospirillum* under supplemental chemical N rates lower than the recommended (Hassanein and Hassouna, 1997; Hamed, 1998; Said, 1998; Ahmed, 2001; Ghallab and Salem, 2001; Abd El-Maksoud, 2002; Khafagy, 2003 and Youssef, Soad *et al.*, 2004).

In general, there is a lake of information concerning the response of wheat genotypes to bio-N fertilization under newly reclaimed areas. Therefore, the present investigation was designed to study the ability of bio-N fertilization treatments combined with five rates of chemical N fertilizer for covering N requirements of two wheat Egyptian cultivars and to protect partially the environment against pollution by extra chemical N fertilizer application.

MATERIALS AND METHODS

The present investigation was carried out during 2003/2004 and 2004/2005 winter growing seasons at El-Boustan Experimental Farm, Faculty of Agriculture, Alexandria University, Damanhour branch, Egypt. This work aims to study the response of two bread wheat (Giza 164 and Sakha 69) to three N bio-fertilization treatments (untreated, Nitrobin and Microbin) and five rates (49, 98, 147, 196 and 245 Kg N/ha) were taken as increment percentage (20, 40, 60, 80 and 100 %) from the recommended amount of mineral N fertilizer (245 Kg N/ha) which was reported by El-Bana and Aly (1993) and Hassan and Gaballah (2000).

Both two nitrogen bio-fertilizers, Nitrobin and Microbin, were supplied by General Organization for Agriculture Equalization, Ministry of Agriculture and Land Reclamation, Egypt. The nitrogen bio-fertilizers as the Nitrobin which contain *Azospirillum* sp, *Azotobacter* sp and Microbin which contain *Azospirillum* sp, *Azotobacter* sp, *Pseudomonas* sp, *Mycorrhiza* sp and *Bacillus megatherium*.

The studied treatments were arranged in a split-split plot design with four replications. The main plots represented wheat cultivars, the sub-plots assigned to the nitrogen bio-fertilizers while mineral nitrogen rates were randomly distributed in the sub-sub plots. The sub-sub plot area was 4.2 m^2 (3.5 x 1.2 m) and consisted of six rows, spaced 20 cm apart. Data of the main chemical and physical properties of the experimental field soil before sowing are shown in Table (1).

Table (1): chemical and physical properties of the experimental field soil before sowing.

Soil variable	Seasons	
	2003/2004	2004/2005
E.C dS/m	1.34	1.32
pH (1:2.5, soil : water)	7.7	7.8
Available nitrogen (µg N/g soil)	10.8	11.4
Available phosphorus (µg P/g soil)	5.2	5.8
Available potassium (µg K/g soil)	85.4	95.6
Organic matter (%)	0.15	0.16
Sand (%)	96.10	96.90
Silt (%)	2.80	2.09
Clay (%)	1.10	1.01
Texture class	Sandy	

Wheat cultivars were sown manually by hand in 7th of December, with seeding rate of 400 grains per m^2, in both seasons. Wheat grains were thoroughly washed in water prior to treat by bio-fertilizer treatments to remove any pesticides added for pest control during storage. The grains were coated just before sowing with bacteria inoculants, at rate of 500 gm inoculations/40 Kg by (5% adhesive agent) Arabian gum.

Phosphorus fertilizer was applied at the rate of 55 Kg P_2O_5/ha as super phosphate (15.5 % P_2O_5) during soil preparation. Likewise, potassium fertilizer was applied at the rate of 48 Kg K_2O/ha as potassium sulphate (48 % K_2O) in two equal doses during soil preparation and at heading of plant growth.

The mineral nitrogen fertilizer, as ammonium sulphate (20.5 % N), was added in three equal doses (at sowing, at 1st and 2nd irrigation). At harvest, the central four rows were used to measure plant height (cm) and grain yield and also yield its components of wheat, including spike length (cm), number of kernels/spike, 1000- kernel weight (g) number of spikes/m^2, straw yield (ton/ha), biological yield (ton/ha) and harvest index % [(grain yield/biological yield) x 100]. The biological yield was determined as the weight of total above ground dry matter. All other culture practices were conducted as recommended.

Four orthogonal comparisons were done for the three studied factors i.e ., C_1: Giza 164 wheat cultivar vs. Skha 69 wheat cultivar ; C_2: uninoculated wheat grains vs. inoculated wheat grains by bio-N fertilizers ; C_3: the wheat grains inoculated by Nitrobin bio – fertilizer vs. wheat grains inoculated by Microbin bio – fertilizer and C_4: among the five rates of chemical nitrogen fertilizer doses as shown in Tables 2 and 3 .

Data were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1981). Significance of different treatments was compared using the least significant differences (LSD) at 0.05 level probability.

RESULTS AND DISCUSSION

1- Cultivars performance:

Means of yield and its studied components as affected by two studied cultivars, irrespective of the N bio-fertilization treatments and rates of chemical N fertilizer in the two growing seasons are presented in Tables 2 and 3. The highest mean values of the studied traits were produced from Giza 164 cultivar and exhibited significant increase in all studied traits compared to Sakha 69 cultivar. The differences between the two studied wheat cultivars could be due to the variation in the genetically make up and their interaction to the environmental conditions prevailing during their growth.

With regard to grain yield (ton/ha), data indicated that, average over two seasons, Giza 164 cultivar showed increase of mean grain yield by 25.49 % as compared with Sakha 69 cultivar. This might be attributed to higher values of its number of spike/m^2, number of kernel/spike and 1000- kernel weight (Table, 3). Several researchers reported significant varied differences among different wheat cultivars in grain yield/ha (Toaima *et al.*, 2000; Saleh, 2003; Ali *et al.*, 2004; and Abdel-Hameed, 2005).

Data in Table (3) indicated that Giza 164 cultivar produced higher straw yield (8.0 ton/ha). Therefore, Giza 164 produced higher biological yield/ha, than Sakha 69 which produced the lower means, in both seasons. Similar results were reported by Toaima *et al.*, 2000; Abdul Galil *et al.*, 2003; Saleh, 2003; Ali *et al.*, 2004 and Abdel-Hameed, 2005.

For harvest index, analysis of variance in Table (2) indicates significant differences between the two studied cultivars in both seasons. The higher harvest index (38.34) was obtained by Giza 164 and the lower ones (36.24) by Sakha 69, as an average of the two seasons (Table 3). These results might be expected since the two tested wheat cultivars had some differences in their genetic structure and their responses to environmental conditions. This findings agree with those obtained by Gaballah (2005) and Salem (2005), however, these results disagree with those reported by Abdul Galil *et al.*, (2003), who reported no significant differences in harvest indices detected among wheat genotypes.

With regard to the number of spikes/m^2, data in Table (3) indicated that Giza 164 had the higher number of spikes/m^2 (401.65), averaged over two seasons and significantly surpassed Sakha 69 cultivar. The results showed that Giza 164 cultivar produced higher means of spike length (9.87 cm) and the differences were highly significant when compared with Sakha 69 cultivar in both seasons (Table, 3).

Table 2: Mean squares for the analysis of variance of wheat grain yield (ton/ha) and yield components as affected by cultivars , nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilizer in 2003/2004 and 2004/2005 growing seasons.

Sources of variation	D.F	Traits									
		Grain yield (ton/ha)		Straw yield (ton/ha).		Biological yield (ton/ha)		Harvest index (%)		No.of spikes /m²	
		/2004 2003	/2005 2004	2003/2004	/2005 2004	2003/2004	2004/2005	/2004 2003	2004/2005	/2004 2003	2004/2005
Replications	3	*	Ns	*	*	*	*	Ns	Ns	**	**
Wheat cultivars (c)	1	**	*	*	**	*	*	*	*	**	*
Error "a"	3	1.20	1.40	3.19	2.07	6.47	9.26	16.25	26.48	6267.25	7448.06
Nitrogen bio-fertilizers (B)	2	**	**	**	**	**	**	Ns	Ns	**	**
C2:-Inoculation vs uninculation	1	**	**	**	**	**	**	Ns	Ns	**	**
C3 :-Nitrobin vs Microbin	1	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
C x B	2	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Error "b"	12	0.58	0.61	2.21	1.81	4.42	4.81	8.8	9.33	3661.1	3918.9
Mineral nitrogen fertilizer % (N%)	4	**	**	**	**	**	**	**	**	**	**
CxN%	4	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
BxN%	8	**	**	**	**	**	**	Ns	Ns	**	**
CxBxN%	8	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Error "c"	72	0.28	0.32	1.31	1.11	2.63	2.22	3.92	4.44	2012.1	2218.6

Ns ,* and ** are not significant and significant at 0 .05 and 0.01 levels , respectively .

Table (2) : Cont.

Sources of variation	D.F	Traits							
		Spike length (cm)		No.of kernels/ spike		1000-kernels weight (gm)		Plant height (cm)	
		2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Replications	3	Ns	Ns	*	*	Ns	Ns	*	*
Wheat cultivars (c)	1	**	**	*	*	*	*	**	**
Error "a"	3	3.56	3.91	55.74	62.57	24.43	30.55	160.58	184.96
Nitrogen bio-fertilizers (B)	2	**	**	**	**	**	**	**	**
C2:-Inoculation vs uninculation	1	**	**	**	**	**	**	**	**
C3 :-Nitrobin vs Microbin	1	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
CxB	2	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Error "b"	12	1.99	2.21	35.20	30.51	13.11	14.40	82.4	91.0
Mineral nitrogen fertilizer % (N%)	4	**	**	**	**	**	**	**	**
CxN%	4	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
BxN%	8	**	**	**	**	**	Ns	**	**
CxBxN%	8	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Error "c"	72	0.62	0.75	12.2	11.3	6.1	6.7	73.82	85.31

Ns ,* and ** are not significant and significant at 0 .05 and 0.01 levels , respectively .

Table 3 : Means of wheat grain yield (ton/ha) and yield components as affected by cultivars , nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilizer in 2003/2004 and 2004/2005 growing seasons.

Trait	Season	Wheat cultivars (c1)		Nitrogen bio-fertilizers				Mineral nitrogen fertilizer					Mean
				Inoculation vs uninoculation (c2)		Nitrobin vs Microbin (c3)		Portions of recommended dose (245 kg/ha); (c4)					
		Giza 164	Sakha 69	Inoculation	Uninoculation	Nitrobin	Microbin	20%	40%	60%	80%	100%	
Grain yield (ton/ha)	2003/2004	4.66(1)a	3.44 b	4.48 a	3.20 b	4.38 a	4.58 a	2.34d	3.33c	4.22b	5.13a	5.24a	4.05
	2004/2005	4.99 a	4.25 b	5.10 a	3.66 b	5.05 a	5.15 a	2.50d	3.61c	4.62b	6.05a	6.34a	4.62
straw yield (ton/ha)	2003/2004	8.44 a	7.36 b	8.69 a	6.31 b	8.48 a	8.90 a	4.02d	5.80c	7.65b	10.79a	11.22a	7.90
	2004/2005	7.56 a	6.30 b	7.66 a	5.49 b	7.44 a	7.87 a	3.75d	5.30c	7.19b	8.96a	9.46 a	6.93
Biological yield (ton/ha)	2003/2004	12.70 a	11.20b	13.17 a	9.51 b	12.86 a	13.48 a	6.36d	9.13c	11.87b	15.92a	16.46a	11.95
	2004/2005	12.47 a	10.65b	12.76 a	9.16 b	12.49 a	13.02 a	6.25d	8.91c	11.81b	15.01a	15.80a	11.56
Harvest index (%)	2003/2004	35.33 a	33.75 b	34.64 a	34.33 a	34.66 a	34.62 a	36.42a	36.69a	35.61a	32.18b	31.79b	34.54
	2004/2005	41.34 a	38.72b	40.00 a	40.10 a	40.48 a	39.51 a	40.08a	40.67a	38.85b	40.38a	40.16a	40.03
No. of spikes /m ²	2003/2004	395.20a	325.04b	378.48 a	323.42 b	368.30 a	388.65 a	224.0d	299.8c	369.60b	445.75a	461.40a	360.12
	2004/2005	408.10a	345.02b	395.66 a	338.36 b	383.90 a	407.41 a	251.10 d	318.12c	387.9b	457.53a	468.13a	376.56
Spike length (cm)	2003/2004	9.81 a	7.31 b	9.47 a	6.73 b	9.28 a	9.66 a	6.44d	7.56c	8.71b	9.87a	10.20a	8.56
	2004/2005	9.92 a	7.22 b	9.09 a	7.54 b	8.89 a	9.28 a	5.76d	7.28c	8.81b	10.35a	10.65a	8.57
No.of kernels / spike	2003/2004	44.24 a	38.74 b	44.07 a	36.33 b	43.32 a	44.82 a	32.07d	37.10c	42.09b	47.13a	49.07a	41.49
	2004/2005	43.44 a	39.22 b	44.95 a	34.09 b	44.11 a	45.79 a	27.77d	34.02c	40.47b	51.49a	52.91a	41.33
1000- kernels weight (gm)	2003/2004	42.50 a	39.62 b	42.18 a	38.81 b	41.85 a	42.51 a	34.50d	37.99c	41.50b	45.03a	46.27a	41.06
	2004/2005	43.25 a	39.61 b	42.57 a	39.14 b	42.15 a	42.99 a	34.57d	38.24c	41.93b	45.64a	46.75a	41.43
Plant height (cm)	2003/2004	86.10 a	72.50 b	82.13 a	73.64 b	80.83 a	83.42 a	56.83d	68.82c	80.92b	93.22a	96.70a	79.30
	2004/2005	87.3 a	73.18 b	84.65 a	71.42 b	82.98 a	86.32 a	56.40 d	69.06c	82.11b	94.94a	98.69a	80.24

(1) Means followed by the same letter , within each row , for each comparison , are not significantly different at 0.05 level .

For the number of kernels/spike, it is observed that the two studied cultivars i.e., Giza 164 and Sakha 69 had highly significant effect on this trait. Giza 164 cultivar gave the higher means value (43.84) while Sakha 69 cultivar gave (38.98).

1000-Kernels weight for Giza 164 cultivar was significantly increased by 7.27 and 9.19 % over the two seasons, respectively, as compared to that recorded for Sakha 69 cultivar (Table 3).

Data of the study showed that Giza 164 cultivar plants was significantly longer by about 19.03% compared with the Sakha 69 as an average of both seasons (Table 3).

The differences in number of spikes/m^2, number of kernels/spike, 1000-kernels weight and plant height between the two studied cultivars might be attributed to the genetic variations. Significant varietals differences regarding those traits were reported by Ahmed, Seham, 2002; Abdul Galil *et al.*, 2003; Saleh, 2003 and Ali *et al.*, 2004.

2- N bio-fertilizer treatments effect:

Regarding the effect of bio-fertilizer treatments, the analysis of variance (Table, 2) clearly showed that the inoculation vs. un-inoculation plants (C_2), were significantly different in both seasons for all studied traits, except harvest index.

Wheat plants obtained from bio-fertilizer treatments gave significant increase in grain yield under investigation in both studied seasons compared with plants that untreated by bio-fertilizers (Table 3). The increments in grain yield per ha due to bio-fertilizer treatments was 39.65 %, as an average of both seasons. The obtained results could be attributed to the role of nitrogen bio-fertilizer in improvement of growth plants especially for sandy soil with poor fertility. In this respect, Rao (1982), Pandy and Kumar (1989) and Kennedy and Tchan (1992) reported that the ability to fix element N is a vital physiological characteristic of *Azotobacter* and *Azosperillum*. In addition, the beneficial effect of these bacteria is related not only to their N-fixing proficiency but also may be to their of ability to synthesize and secrete antibacterial and growth regulators antifungal compounds, and vitamins in the plant rahizosphere.

Bio-fertilized plants significantly produced higher means of straw yield per hectare estimated by 37.72 and 39.53 %, in the first and second seasons, respectively, compared with untreated one (Table, 3). These results may be due to the beneficial effect of bio-fertilizers on growth parameters i.e., plant height and number of tillers/plant.

Significant increase for biological yield by 38.89 %, as an average of both seasons, was recorded by bio-fertilized plants compared with untreated one. This might be due to the effect of bio-fertilizers on improving biological components, i.e., grain yield, straw yield, number of spikes/m^2, spike length, number of kernels/spike, 1000-kernels weight and plant height (Table, 3).

Treating wheat by bio-fertilizers caused insignificant increase in harvest index in both seasons, compared with untreated plants.

The significant increase in number of spikes/m^2 was 16.98 %, as an average of both seasons. This indicates the role of bio-fertilizers in encouragement of spike formation associated with nutrients and hormones, i.e., cytokinens, GA_3 and IAA which increase vegetation growth and number of spikes/m^2 (Yossef, Soad *et al.*, 2004). In this concern, Hamed (1998), Said (1998) and Farag (2003) reported similar results.

Both spike length and plant height for bio-fertilized plants were significantly longer and taller, in both seasons, compared with the untreated one (Table, 3). This trend of results could be explained on the basis of the mode of action of the bio-fertilizers. The authors attributed that to exertion on some growth regulators which promote all division and elongation which resulted in longer spike and tallest plants. In this respect, El-Khawas (1990) attributed the increase in plant growth to bio-fertilizations. The principal mechanism that bio-fertilizer could benefit the plant growth is through fixing gaseous nitrogen and its transfer to the plant as a direct effect on growth hormones that released in root media by bacteria and positively effect on the growth and extension. These results also are in harmony with those reported by Sharief *et al.*, (1998), Abd-El-Maksoud (2002), Farag (2003) and Yossof, Soad *et al.*, (2004).

Treated plants by bio-fertilizers were significantly exceeded un-bio-fertilized one with 26.41 and 8.72% for number of kernels/spike and 1000-kernels weight, respectively, as an average over both seasons (Table, 3). These results clearly indicated improving of plant growth, sink input, photosynthetic rate and assimilation production by N bio-fertilizers. In this concern, Atta Allah (1998) attributed the nitrogen fixation by non-symbiotic bacteria present in Serealen and Microbin for their ability to fix free molecular nitrogen, stimulate germination, improve plant stand, synthesis of chlorophyll, secrete hormones and consequently increase uptake of nutrients by maize plants.

Regarding the comparison between the two studied bio-fertilizers (Nitrobin vs. Microbin), C_3; the data in Table (2) revealed that the differences not reach to the level of significance for all studied traits in both studied seasons. In spite of insignificant differences, the Microbin tended to improve all studied traits in both seasons, except harvest index. This result might be due to composition of Microbin which contained more different species of nitrogen fixers which produce more growth regulators encourage roots to have more nutrient elements. Thus, the averages of studied traits were higher with respect to Microbin compared with Nitrobin. The relative increase for Microbin than Nitrobin were estimated by (3.18, 5.34, 4.54, 5.83, 4.24, 3.64, 1.79, and 3.62 %) for grain yield/ha, straw yield/ha, biological yield/ha, number of spikes/m^2, spike length, number of kernels/spike, 1000-kerenl weight and plant height, respectively, as an average over both seasons (Table, 3).

3- The chemical N fertilizer effect:

Table (2) shows that all studied traits of the two studied wheat cultivars were highly significantly affected by mineral N fertilizer treatments in two growing seasons. It was clearly evident from Table (3) that increments of mineral N fertilizer from 49 to 196 Kg N/ha showed significant increase of all studied traits for both cultivars, except harvest index, and the differences of studied traits were insignificant for rates of 196 and 245 Kg N/ha, in both seasons. Therefore, the highest values of all studied traits, except harvest index, were achieved by 245 Kg N/ha application, while the 49 Kg N/ha gave the lowest value. This positive response to increase of N application was expected since the study was conducted in poor fertile sandy soil as shown in Table (1). The obtained results could be attributed to the positive role of nitrogen to increase photosynthesis activities which cause more flower fertility, setting per spike and stimulation of the plant capacity in building more metabolites to develop that increase grain yield. In the literature, many studies indicated that nitrogen element play an essential role in plant biochemistry and plant physiology. So, the amount of chemical nitrogen applied to wheat crop must be managed to ensure that nitrogen is available throughout the growth season because of its important role in enhancing both vegetative and reproductive development (Abdel-Hameed, 2005).

4- Interaction effects:

Data in Table (2) showed highly significant interaction effects between the two studied factors i.e., nitrogen bio-fertilizer treatments and rates of chemical N fertilizer on all studied traits, except harvest index, in both seasons. Wheat plants inoculated with the Microbin and received 245 Kg N/ha of chemical N fertilizer produced the highest values of grain yield/ha, straw yield/ha, biological yield/ha, number of spike/m^2, spike length, number of kernel/spike, 1000-kernel weight and plant height, in both seasons, without significant differences between similar treatments at 196 Kg N/ha of chemical N fertilizer. On the other hand, un-inoculated wheat plants and received 49 Kg N/ha produced the lowest values of all studied traits (Tables, 4, 5, 6, 7, 8, 9, 10 and 11).In this concern, El-Naggar *et al.*, (2005) observed that plants which treated with bio-fertilizers and received the rates of mineral fertilizer showed significant enhancement of vegetative growth parameters, chemical compositions of plant leaves and availability of N, P, and K in the soil.

Again, the beneficial effects of nitrogen bio-fertilizer on grain yield and its components might be attributed to the vigorous growth caused by bio-fertilized plants and to the increase in the metabolites synthesis of these plants as well as to the roles of bio-fertilizer to improve the absorption of the nutrients especially P, Fe, Zn, Mn and Cu which play important role in activation the metabolic process (Mohamed, 2000). In this concern, Hassan *et al.*, (2006) indicated that the enhancing effects of N bio-fertilizer on growth traits in plants may be attributed to many factors such as release of plant promoted substances, mainly indole acetic acid (IAA), gibbrelic acid (GA_3) and cytokinin which may stimulate plant growth, synthesis of some vitamins as B_{12}, increasing amino acids content, enhancing the production of biologically active fungistatic substances which may change the micro flora in the ryhizosphere and affect the balance between harmful and beneficial organisms and increasing water and minerals uptake from soil. This may be ascribed to increase root surface area, root hairs and root elongation as affected by bio-fertilizer.

Table 4 : Means of grain yield (ton/ha) of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

Season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	1.36	2.71	3.46	4.21	4.26	0.53
	Nitrobin	2.75	3.54	4.50	5.49	5.62	
	Microbin	2.92	3.75	4.71	5.69	5.83	
2004/2005	Uninoculated	1.69	2.69	3.30	5.20	5.50	0.57
	Nitrobin	2.84	4.05	5.31	6.37	6.66	
	Microbin	2.97	4.09	5.25	6.59	6.86	

Table 5 : Means of straw yield (ton/ha) of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

Season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	2.61	4.35	6.14	9.11	9.33	1.14
	Nitrobin	4.61	6.35	8.16	11.37	11.91	
	Microbin	4.84	6.70	8.65	11.89	12.42	
2004/2005	Uninoculated	2.49	3.76	5.75	7.45	8.00	1.05
	Nitrobin	4.16	5.86	7.74	9.50	9.94	
	Microbin	4.60	6.28	8.09	9.93	10.45	

Table 6 : Means of biological yield (ton/ha) of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	3.97	7.06	9.60	13.32	13.59	1.62
	Nitrobin	7.36	9.89	12.66	16.86	17.53	
	Microbin	7.76	10.45	13.36	17.58	18.25	
2004/2005	Uninoculated	4.18	6.45	9.04	12.65	13.50	1.49
	Nitrobin	7.00	9.91	13.05	15.87	16.60	
	Microbin	7.57	10.37	13.34	16.52	17.31	

Table 7 : Means of number of spikes/m² of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	188.00	263.86	331.20	411.95	422.10	44.86
	Nitrobin	231.00	307.11	379.80	452.81	470.80	
	Microbin	253.00	328.67	397.80	472.49	491.30	
2004/2005	Uninoculated	219.00	280.12	352.60	413.90	426.20	47.10
	Nitrobin	256.10	325.80	395.70	466.80	475.10	
	Microbin	278.20	348.44	415.40	491.89	503.10	

Table 8 : Means of of spike length (cm) of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	4.75	5.56	6.91	8.01	8.41	0.79
	Nitrobin	6.94	8.30	9.42	10.70	11.02	
	Microbin	7.59	8.82	9.80	10.90	11.18	
2004/2005	Uninoculated	5.01	6.45	7.79	9.13	9.49	0.87
	Nitrobin	5.98	7.57	9.13	10.70	11.09	
	Microbin	6.29	7.98	9.51	11.22	11.38	

Table 9 : Means of number of kernels/spike of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	28.97	32.60	35.99	40.80	43.30	3.49
	Nitrobin	32.73	38.49	44.58	49.79	51.01	
	Microbin	34.51	40.21	45.70	50.80	52.90	
2004/2005	Uninoculated	23.99	29.12	32.65	41.49	43.21	3.36
	Nitrobin	29.79	35.38	43.71	55.63	57.05	
	Microbin	30.53	37.56	45.06	57.35	58.47	

Table 10 : Means 1000-kernels weight (g) of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	2.1035.	35.11	39.39	43.17	44.28	2.47
	Nitrobin	42	39.00	42.30	45.63	46.92	
	Microbin	35.98	39.86	42.81	46.29	47.60	
2004/2005	Uninoculated	32.77	36.24	39.10	43.20	44.37	2.59
	Nitrobin	35.06	38.89	42.99	46.41	47.42	
	Microbin	35.88	39.99	43.70	47.31	48.46	

Table 11 : Means of plant height (cm) of wheat as affected by the interaction between nitrogen bio-fertilizers and portions of recommended mineral nitrogen fertilization (B x N%) in 2003/2004 and 2004/2005 growing seasons.

season	Nitrogen bio-fertilizers	Portions of recommended mineral nitrogen fertilization					LSD 0.05
		20%	40%	60%	80%	100%	
2003/2004	Uninoculated	51.63	64.38	75.11	86.77	90.31	8.59
	Nitrobin	57.55	69.76	82.27	95.62	98.95	
	Microbin	61.31	72.32	85.38	97.27	100.83	
2004/2005	Uninoculated	49.90	60.90	71.00	85.90	89.40	9.24
	Nitrobin	57.63	71.34	86.13	97.85	101.96	
	Microbin	61.67	74.94	89.20	101.07	104.70	

Finally, it could be concluded that in order to reduce the environmental pollution as a result of using chemical nitrogen, inoculation of wheat grains with Microbin bio-fertilizer could compensate about 20 % of plant requirements of mineral nitrogen fertilizer and decrease wheat plant production costs under sandy soil conditions.

REFERENCES

Abd El- Maksoud, M.F. (2002). Response of some wheat cultivars to biofertilizer and nitrogen fertilizer levels. Zagazig J. Agric. Res. 29(3):891-905.

Abdel-Hameed, I.M. (2005). Response of two newly released bread wheat cultivars to different nitrogen and phosphorus fertilizer levels. Proceed, 1st Sci. Conf. Cereal Crops, June 20-21. Alex. J. Agric. Res. 50 (2B) 63-77, Special Issue..

Abdul Galil, A.A.; H. A. Basha; S.A.E. Mowafy and M.M. Seham (2003). Effect of phosphorus addition on the response of four wheat cultivars to N fertilization level under sandy soil conditions. Minufiya J. Agric. Res. 28 (1):1-22.

Ahmed, M.K.A. (2001). Effect of biofertilizers and sulfar on yield of two barley cultivars grown in newly reclaimed sandy soils. J. Agric., Sci. 26(5):2611-2615 Mansoura. Univ., Egypt.

Ahmed, Seham, M.M. (2002). Response of some wheat cultivars to nitrogen and phosphorous fertilization under sandy soil conditions. M.Sc. Thesis, Fac. of Agric. Zagazig Univ., Egypt.

Ali, A. A.; O.E. Zeiton; A. H. Bassiony and A.Y.A. El-Bana (2004). Productivity of wheat cultivars grown at El-Khattara and El-Arish under different levels of planting densities and N-fertilization. Zagazig J. Agric. Res. 31 (4A):1225-1256.

Atta-Allah, S.A.A. (1998). Response of maize to nitrogen and biofertilizer. Assiute J. Agric. Sci. 29(1):59-73.

Bohiool, B. B.; F. K. Ladha; D. P. Garrity and T. Geoge (1992). Biological nitrogen fixation for sustainable agriculture. A perspective Plant and Soil 141: 1 – 11.

El-Aggory, Eglal A.; S. Alloam; Nadia O. Monged and A. Kh. Ahmed (1996). A comparative study on using biofertilizer, and micronutrients to reduce the rate of mineral N-fertilizers for wheat plant in sandy soil. Egypt J. Appl. Sci. 11 (11): 286 - 300.

El-Bana, A.Y.A. and Aly (1993). Effect of nitrogen fertilization levels on yield and yield attributes of some wheat cultivars in newly cultivated sandy soil. Zagazig J. Agric. Res. 20(6):1739-1749.

El-Khawas, H.(1990). Ecological, physiological and genetic studied of *Azospirillum*. Ph. D. Deseritation. Buyreuth. Univ., Germany .

El-Naggar, A. A. M.; F. M. El-Fawakhry and A. I. Sharaf (2005). Effect of biofertilizers, organic manure, and mineral fertilizer on production of *Narcissus tazetta*, L. bulbs grown on sandy loam soil. J. Agric. Sci. 30(3): 1795-1816 Mansoura Univ., Egypt.

Farag, A.M.H. (2003). Response of wheat plants to some treatments of soil leveling and fertilization wheat with both nitrogen and biological fertilizers. Ph. D. Thesis Fac. of Agric. Mansoura. Univ., Egypt.

Gaballah, AL-S.B. (2005). Effect of splitting nitrogen fertilizer rates on yield determinations of some wheat cultivars grown in sandy soil. J. Agric. Sci. 30 (11):6491-6502 Mansoura Univ., Egypt.

Ghallab, A.M. and S.M. Salem (2001). Effect of some biofertilizer treatments on growth, chemical composition and productivity of wheat plants grown under different levels of NPK fertilization. Annals Agric. Sci. 46(2):485-509 Ain Shams Univ., Cairo, Egypt.

Hamed, M.F. (1998). Wheat response to inoculation, source and rate of nitrogen fertilization. J. Agric. Sci. 2(3):1021-1027 Mansoura Univ., Egypt.

Hassan, A.A. and A.B. Gaballah (2000). Response of some wheat cultivars to different levels and source of N fertilizers under new reclaimed sandy soils. Zagazig J. Agric. Res. 27(1):13-29.

Hassan, H.R.; D.M. Nassar and M.H. Abou-Bakr (2006). Effect of mineral and bio- fertilizer on growth, yield components, chemical constituents and anatomical structure of moghat plant (*Glossostemon bruguieri Desf.*) grown under reclaimed soil conditions. J. Agric. Sci. 31(3):1433-1455 Mansoura Univ., Egypt.

Hassanein, M.A. and M.G. Hassouna (1997). Use of biofertilizer for barley cropping under rainfall conditions in the Northwestern Coast of Egypt. Alex. Sci. Exch.; 18:19-25.

Kennedy,I.R. and Y.T. Tchan (1992). Biological nitrogen fixation in non leguminous field crops: recent advances. Plant and Soil 141: 93-118.

Khafagy, H.A. (2003). Biofertilizer and organic matter in the improvement of plant growth and soil fertility in some newly reclaimed soils. Ph. D. Thesis, Fac. of Agric., Microbiology Dept., Mansoura Univ., Egypt.

Mohamed, S.A. (2000). Effect of mineral and bio- fertilization on growth, yield, chemical constituents and anatomical structure of wheat (*Triticum asetivum* L.) and broad bean (*Vicia faba* L.) plants grown under reclaimed soil conditions. Annals of Agric. Sci., Moshtohor, 38(4):2039-2063.

Pandey, A. and S. Kumar (1989). Potential of *Azotobacter* and *Azospirillum* as biofertilizers for upland cotton agricultures. A review J. Sci. and Industrial. Res. 48(3):134-144.

Rao, N.S. (1982). Biofertilizers in agricculture. Oxford IBH Publishing Co., New Delhi, India.

Saber, M.S.M. (1993). A multi-strain biofertilizer. The sixth international symposium on nitrogen fixation with non-legumes. Ismailia Egypt, 6-10 September.

Said, M.A. (1998). Studies on productivity of barley response to mineral and biofertilizer in the newly reclaimed Lands. M. Sc. Thesis, Fac.of Agric., Alex. Univ., Egypt.

Saleh, M.E. (2001). Wheat productivity as affected by sources and levels of nitrogen fertilizer. Zagazig J. Agric. Res., 28(2): 239-250.

Saleh, M.E. (2003). Response of Egyptian and Mexican wheat cultivars to different nitrogen fertilization levels under U.A.E. conditions. Zagazig J. Agric. Res. 30(4):1189-1201.

Salem, M.A. (2005). Effect of nitrogen rates and irrigation regimes on yield and yield component of bread wheat (*Triticum aestivum* L.) genotypes under newly reclaimed land condition. J. Agric. Sci 30(11):6481-6490 Mansoura Univ., Egypt.

Sharief, A.E.; S.E. El-Kalla; A.A. Leilha and H.E.M. Mostafa (1998). Response of wheat cultivars to nitrogen fertilizer levels and biological fertilization J. Agric. Sci. 23(12):5807-5816 Mansoura Univ., Egypt.

Snedecor, G.W. and W.G. Cochran (1981). Statistical Analysis Methods. 7th. Ed. Iowa State. Univ. press, Iowa, U.S.A.

Sorour, F. A.; S. M. Al-Aishy; M. E. Moslem; M. M. Abdel-Hamid and A. E. Khaffagy (2004). Effect of some tillage systems and weed control treatments on annual weeds, and wheat grain yield and its components. J. Agric. Res. 30(2):246-260. Tanta Univ., Egypt

Toaima, S.E.A.; A.Amal, El-Hofi and H. Ashoush (2000). Yield and technological characteristics of some wheat varieties as affected by N-fertilizer and seed rates. J. Agric. Sci. 25(5):2449-2467. Mansoura Univ., Egypt

Youssef, Soad A., E.E. El-Sheref, A.A.El-Hag and A.A. Rania (2004). Effect of nitrogen levels and biofertilizer sources on two barley cultivars. J. Agric.. Sci. 29(12):6787-6808. Mansoura Univ., Egypt.

تحسين إنتاجية القمح بالتسميد الحيوي في الأراضي الرملية حديثة الاستزراع

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أجريت هذه الدراسة بأرض رملية بالمزرعة البحثية بالبستان-كلية الزراعة بدمنهور – جامعة الإسكندرية – خلال موسمي ٢٠٠٣/٢٠٠٤ و٢٠٠٤/٢٠٠٥ ، وقد صممت هذه الدراسة لتقييم إنتاجية صنفين من القمح هما (جيزة ١٦٤، سخا ٦٩) بثلاث معاملات من التسميد الحيوي (مقارنة، معاملة الحبوب بالنيتروبين ، معاملة الحبوب بالميكروبين) مع التسميد النيتروجينى المعدني بخمسة مستويات (٢٠ & ٤٠ & ٦٠ & ٨٠ و ١٠٠% من المعدل الموصى به وهو ٢٤٥ كجم/هكتار)

وفيما يلي أهم النتائج المتحصل عليها:-

تفوق الصنف جيزه ١٦٤ معنويا على الصنف سخا٦٩ في كل الصفات التى تم دراستها (محصول الحبوب / هكتار ، محصول التبن / هكتار ، المحصول البيولوجى / هكتار معامل الحصاد (%) ، عدد السنابل / م٢ ، طول السنبلة ، عدد الحبوب / سنبله ، وزن الألف حبه وطول النبات) وذلك في كلا موسمي الدراسة .

أدى تلقيح حبوب القمح بالتسميد الحيوي (النيتروبين والميكروبين)قبل زراعتها الى إحداث زيادة معنوية في كل الصفات التى تم دراستها في -كلا موسمي الدراسة- باستثناء صفة معامل الحصاد وذلك مقارنة بالحبوب التى لم يتم تلقيحها ، وقد أعطت الحبوب الملقحة بالميكروبين زيادة غير معنوية في متوسطات كل الصفات التى تم دراستها -في كلا موسمي الدراسة- باستثناء صفة معامل الحصاد مقارنة بتلك التي تم تلقيحها بالنيتروبين .

ومع كل زيادة في مستوي التسميد النيتروجينى المعدني وذلك من ٢٠ وحتى ٨٠ % من معدل السماد الموصى به سُجلت زيادة معنوية في جميع الصفات التى تم دراستها باستثناء صفة معامل الحصاد – في كلا موسمي الدراسة – غير أن زيادة التسميد النيتروجينى المعدني إلى ٢٤٥كجم/هكتار(١٠٠% من المعدل الموصى به) لم تؤد إلى زيادة معنوية في جميع الصفات التى تم دراستها مقارنة بالتسميد النيتروجينى المعدني بنسبة ٨٠%من المعدل الموصى به .

كان التفاعل بين أنواع التسميد الحيوي ومعاملات التسميد المعدني عالي المعنوية وذلك بالنسبة لجميع الصفات التى تم دراستها – باستثناء صفة معامل الحصاد – في كلا موسمي الدراسة .

توصى هذه الدراسة بأهمية زراعة صنف القمح جيزة ١٦٤ وتلقيح الحبوب قبل زراعتها بالسماد الحيوي (الميكروبين) مع تسميد النباتات بمعدل ١٩٦ كجم/هكتار من السماد النيتروجينى المعدني أي بمعدل ٨٠% من المعدل الموصى به وذلك لإنتاج محصول جيد من حبوب القمح وكذا المساهمة في تقليل التلوث البيئي نتيجة لتقليل التسميد النيتروجيني المعدني بمعدل ٢٠% وذلك في الأراضي الرملية حديثة الاستزراع .