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RESPONSE OF WHEAT CULTIVARS (*Triticum aestivum* L.) TO THE MINERAL NITROGEN AND BIO-FERTILIZER APPLICATIONS AT SOUTH SINAI GOVERNORATE IN EGYPT

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Two field experiments were conducted at Ras-Sudr Research Station, South Sinai Governorate during two successive seasons, 2003/2004 and 2004/2005 to study the effect of three levels of nitrogen (30, 45 and 60 kg N as ammonium sulfate/fed., Hectare = 2.38 fed.) and two bio-fertilizers (Rhizobacterein, and Biogen) with two wheat cultivars (Giza 168 and Sids 1, *Triticum aestivum* L., 2n = 42). Obtained results showed that increasing of the nitrogen fertilizer from 30 up to 60 Kg N/fed. significantly increased all yield and yield components in each growing seasons. Rhizobacterein was recorded as superior than Biogen for all yield criteria with Giza 168, in the growing seasons. Giza 168 was superior to Sids-1 in all yield criteria in the two growing seasons. The effect of the second order interaction indicates that inoculating of the Giza 168 with Rhizobacterein (Azotobacter *chroococcum* + *Azospirillum brasilense*), fertilized with 30 kg mineral N /fed. has been given the highest yield and yield components in the two growing seasons. Interaction between bio-fertilizers and mineral N fertilizer have been resulted higher grain protein than the control. In addition, interaction between Giza 168, inoculated with Rhizobacterein and fertilized with 60 kg N /fed., significantly increased the percentage of K, K/Na ratio, N, and grain and straw protein of the cultivars in the two seasons. It could be concluded that Rhizobacterein saves half of the mineral nitrogen fertilizer dose coinciding with producing high yield, yield attributes and chemical contents under South Sinai region, Egypt. Therefore, Rhizobacterein + ½ dose of mineral nitrogen (30 kg N/ fed.) encourage the farmers to usage of bio-fertilizer and decreased nitrogen levels, hence save money, decreased the pollution and gave promising grain yield.

Keywords: wheat, cultivar, mineral N fertilizer, bio-fertilizer, response, grain yield, South Sinai.

Wheat is considered as one of the most important cereal in the world. In Egypt, wheat crop has a special importance because the local production is not sufficient to supply the annual demand of population. Wheat area is about 2.46 million fed. in the old and new lands in 1999/2000 season where, its production reached 6.56 million tons. Hence, the imported wheat was decreased to 4.5 million tons, in 1999 compared with 7.3 million tons in 1987 (Noureldin, *et al.*, 2000). Therefore, most of the horizontal extension for plant production is carried out in new reclaimed soils particularly in sandy loam ones which suffer from structure, nutrition problems and lack of water. (Yassen, 1993). New reclaimed soil under these conditions i.e. saline soil requires substantial amount of nutrients for higher productivity.

Nitrogen is one of the most important elements in the nutrition of higher plants and one of the most expensive inputs in the production of winter wheat, in Egypt. On the other hand, it is a major nutrient that influences of the grain yield and protein concentration in wheat, also. When the amount of available soil N limits yield potential, additions of N fertilizers may be substantially increase grain yield. However, concentration of the grain protein may decrease if the amount of added N is not adequate (McNeal and Davis, 1954; Terman *et al.*, 1969 and Grant *et al.*, 1985).

Bio-fertilizers are good source of nutrients and increase organic matter in soil. It may not only activate N_2-fixation but also growth and production, yield level as well as producing of the growth regulators such as auxin, cytokine, gibberellins,...etc., that increases the grain yield (El-Kased *et al.*, 1996). In wheat, the integrated approach of nutrient supply by chemical fertilizers along with bio-fertilizers is gaining importance because this system not only reduces the use of inorganic fertilizers but also is an environment friendly approach. Bio-fertilizer technology is practiced for increasing agricultural production, to limit the use of chemical fertilizers and pollution of environment through seed inoculation by different types of bacteria (Abd El-Ghany, 1994). The aim of this research is to see and detect the effect of two bio-fertilizers and three doses of nitrogen minerals and two wheat cultivars under saline stress conditions at the Ras-Sudr region.

MATERIALS AND METHODS

Two field experiments were conducted at Wadi Sudr region, Agricultural Experimental Station of Desert Research Center, South Sinai Governorate, Egypt, during the winter of 2003 / 2004 and 2004 / 2005.The aim is to study the effect of mineral nitrogen fertilizers and bio-fertilizers on two bread wheats (Giza 168 and Sids 1, *Triticum aestivum* L.). Results of the

physical and chemical analysis of the experimental site's soils are presented in table (1). As seen from the table (1), the soil is highly calcareous, loamy sand in texture with high salt content.

TABLE (1). Results of the physical and chemical analysis of the experimental site.

Years	Sand %	Silt %	Clay %	Soil Texture	Ca CO_3 %
2003-2004	80.50	11.40	8.10	Sandy loam	52.30
2004-2005	74.47	16.90	8.63	Sandy loam	54.30

Chemical analysis										
Years	pH	EC dS/m	Soluble Cations (meq/100g)				Soluble Anions (meq/ 100g)			
			K^+	Na^+	Mg^{++}	Ca^{++}	$SO4^-$	Cl^-	HCO_3	$CO3^-$
2003/2004	7.28	8.36	20.4	12.98	35.83	0.54	14.75	12.5	3.00	--
2004/2005	8.1	9.58	22.60	10.60	34.00	0.40	14.50	15.8	2.1	--

Experiment was arranged in a split-split plot design with four replicates. Treatments were located as the combination of the cultivars (Giza 168 & Sids 1) in main plot, bio-fertilizers Rhizobacterein (Azotobacter chroococcum + Azospirillum brasilense) and Biogen (Azotobacter chroococcum) and one treatment as a control (un-inoculated) to the sub-plots and three doses of mineral nitrogen (ammonium sulfate 20.6 %) fertilizers (30,45and 60 kg N /fed.) in sub-sub plots were applied in a three equal doses (before sowing, on the tillering and before flowering). Using bio-fertilizers were supplied from Agriculture Research Center, Giza. The area of each plot is 2x3m= 6m2 which contains 4 rows (3 m length, 50 cm width). Sowing was done on December 6th and 4th in 2003 and 2004, at seeding rate of 80 Kg/fed. for the two successive growth seasons, respectively. Grain of two wheat varieties were soaked with tap water for 12 hours then dried before planting.

Recommended agricultural practices were done as followed by the growers of the region. At harvest, after 160 days, randomized ten plants selected from each plots and these agro- morphlogical traits were determined by Grant *et al.* (1985) as plant height (cm), spike length (cm), number of spikelets / spike, weight of 1000seed (gm), number of spikes /m^2, biological yield (kg /fed.), grain yield (kg /fed.) and straw yield (kg /fed.) (whereas, 1000 kg = ton) Noureldin, *et al.* (2000). In addition, samples were chosen for the chemical analysis determining the percentage of potassium, sodium and K/Na ratio (calculate by divided potassium on sodium). (El-Kased *et al.*,1996). Nitrogen and protein (N X6.25) values were calculated as described by A.O.A.C. (1980). All obtained data were statistically analyzed according to Snedecor and Cochran (1981) and means were grouped by LSD test at the 5% probability level.

RESULTS AND DISCUSSION

A. Wheat Yield and Its Components

A-1 Wheat cultivar difference

Data in table (2) and fig (1) show that Giza 168, cultivar was significantly superior than Sids 1, cultivar in wheat yield and its components in the two growing seasons. These results may be due to the higher in number of spikelets/ spike, number of grain/ spike, weight of 1000 grain and number of spikes /m^2. Coinciding with these obtained by Jackson *et al.* (1990) who found that wheat cultivar Yecora Rojo has different yield than Anza, or Yolo, cultivars.

A-2 Effect of different Bio-fertilizers

Wheat plant inoculated with Rhizobacterein produced higher grain yield and its components than those inoculated with Biogen. These results were true in the two growing seasons, contradicting results were obtained on straw yield (Table 3 and Fig 2). The mixture of the two species of bacteria (*Azotobacter chroococcum* +*Azospirillum brasilense*), may supply more plant hormones (auxin, cytokine, gibberellins...etc.) as reported by El-Kased *et al.*(1996). Singh and Pan war (1997) found growth improvement by inoculation with *Azotobacter chroococcum* or *Azospirillum brasilense*. These may be due to recycling nutrient elements as a natural resources and increase the amount of fixed nitrogen in plant and all over the soil, as a role of both Azotobacter and Azospirlla together or alone, nitrogen fixing bacteria, produce active substances help in plant nutrient uptakes. Sushila and Giri (2000) reported similar findings of increased grain yield of wheat with bio-fertilizers.

A-3 Effect of mineral nitrogen fertilizer

Increasing mineral nitrogen fertilizer levels from 30 up to 60 kg N /fed. increased significantly wheat yield and its components in the two growing seasons, except, spike length that not reached the 5 % level of significance in the first season (Table 4 and Fig 3). The increase of straw yield is a reflection of the vegetative growth which is generally improved by nitrogen application (El- Kased *et al.*,1996). These results are confirmed with Tomar *et al.* (1997) who found that the higher grain yield of wheat was obtained with increasing the application of mineral N fertilizer. Yield increase was due to great number of spikelets / spike, number of grain/ spike, weight of 1000 grain and number of spikes /m^2 as mentioned by Evans (1983) and Anthony and Howard (2003) who reported the addition of N fertilizers may be substantially increase wheat grain yield.

TABLE (2). Cultivars differences in yield components of wheat plant in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Criteria Treatments	Plant height (cm)		Spike length (cm)		No. of spiklets/spike		No. of grain/spike		Weight of 1000seed (gm)		No. of spikes/m²	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Giza 168	53.89	54.44	7.43	7.47	15.51	15.54	24.93	24.89	66.87	66.03	731.96	710.52
Sids 1	40.39	38.95	6.51	6.39	14.96	15.03	16.50	16.52	51.02	50.82	418.37	408.48
LSD at 5%	0.45	0.17	0.29	0.03	0.06	0.04	0.13	0.03	0.53	0.46	6.01	23.06

TABLE (3). Response of wheat yield components to bio-fertilizer in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Criteria Treatments	Plant height (cm)		Spike length (cm)		No. of spiklets/spike		No. of grain/spike		Weight of 1000seed (gm)		No. of spikes/m²	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Uninoculate	38.23	37.13	6.15	6.09	14.68	14.75	17.20	17.13	51.62	51.01	406.17	392.00
Rhizobactrei	51.69	52.18	7.41	7.39	15.61	15.63	23.37	23.43	63.36	62.49	665.17	661.33
Biogen	51.49	50.77	7.35	7.25	15.42	15.47	21.57	21.57	61.85	61.78	654.17	625.17
LSD at 5%	0.90	0.47	0.43	0.03	0.04	0.02	0.173	0.03	0.17	0.77	14.84	33.62

TABLE (4). Response of wheat yield components to N fertilizer in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Criteria Treatments	Plant height (cm		Spike length (cm)		No. of spiklets/spike		No. of grain/spike		Weight of 1000seed (gm)		No. of spikes/m²	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30kg N/fed.	46.09	46.02	6.84	6.74	14.95	14.99	19.93	19.96	56.75	55.79	538.67	519.17
45 kg N/fed.	47.18	46.68	6.92	6.86	15.23	15.28	20.46	20.52	58.47	58.82	562.33	554.39
60 kg N/fed.	48.15	47.39	7.14	7.13	15.52	15.57	21.75	21.65	61.61	60.66	624.50	604.94
LSD at 5%	0.28	0.09	Ns	0.02	0.04	0.02	0.09	0.04	1.23	0.46	9.02	16.86

Ns = not significant

A-4 First order interactions (Between two factors)

A-4-1 Effect of the interaction between cultivars and bio-fertilizer

Response of the cultivars to the used bio-fertilizer was significant on wheat yield and its components in the two growing seasons. From them, inoculation Giza 168 with Rhizobacterein was the best treatment. It could be concluded that bio-fertilization of Rhizobacterein contribute a considerable effect on the wheat cultivars and the effect of Rhizobacterein, for N-fixing bacteria as a bio-fertilizer, mixture (*Azotobacter chroococcum* + *Azospirillum brasilense)*, enhance the grain production and biological yield of Giza-168 (Table 5 and Fig 4). The bio-fertilizers are useful for recycling nutrient elements as a natural resource and increase of the amounts of fixing nitrogeous in plant and the soil.

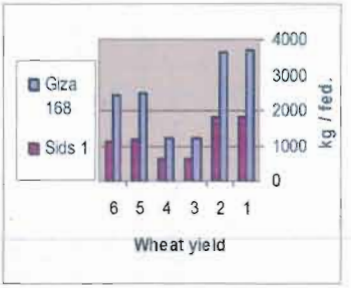

Fig (1). Cultivars differences in yield on:
1- biological yield in the first season, 2-biological yield in the second season, 3- grain y. in the first season, 4- grain y. in the second season, 5-straw y. in the first season and 6 - straw y. in the second season .

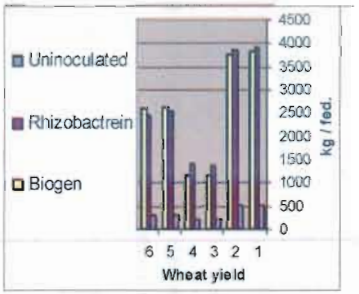

Fig (2). Response of wheat yield to biofertilizer on:
1- biological yield in the first season, 2-biological yield in the second season, 3- grain yield in the first season, 4- grain yield in the second season, 5-straw yield in the first season and 6 - straw yield in the second season .

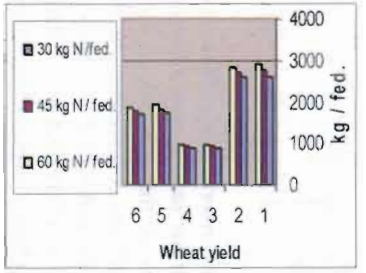

Fig (3). Response of wheat yield to mineral nitrogen fertilizers on:
1- Biological yield in the first season, 2-biological yield in the second season, 3- grain yield in the first season, 4- grain yield in the second season, 5-straw yield in the first season and 6 - straw yield in the second season .

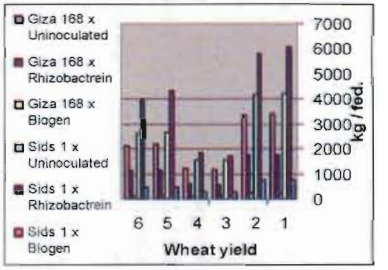

Fig (4). Response of two wheat cultivars yield components to biofertilizers on:
1- biological yield in the first season, 2-biological yield in the second season, 3- grain yield in the first season, 4- grain yield in the second season, 5-straw yield in the first season and 6 - straw yield in the second season .

A-4-2 Effect of the interaction between cultivars and mineral N fertilizer

The response of the two cultivars to mineral N fertilizer on wheat yield and its components in the two growing seasons was significant except of plant height and number of spikes /m^2 in the first growing season. The promising treatment was fertilized Giza 168 with 60kg N /fed. (Table 6 and Fig 5).These results are in harmony with those observed by Singh (1997) and Gill and Pawandeep (2003) who found that plant height and wheat yield increased with increasing N level, to different varieties .

A-4-3 Effect of the interaction between bio-fertilizer and mineral N fertilizer

The effect of the interaction between bio-fertilizer and different levels of mineral N fertilizer on wheat yield and its components in the two growing seasons was significant (Table 7 and Fig 6). Among the bio-fertilizers Rhizobacterein proved more effectiveness with 30 kg mineral N /fed. This treatment was significantly superior than inoculated with Biogen. Incorporation bio-fertilizers not only increased yield attributes but also increased grain and straw yield of wheat. Bio-fertilizers like Rhizobacterein and Biogen supplemented 50% (30 kg N /fed.) of the recommended dose of N in wheat which not only reduce the chemical fertilizers but also equalized the yield of wheat when compared with 100 % (60 kg N /fed.) of the recommended dose of N. In addition may improve wheat utilization of fertility status (Singh and Pan war, 1997).

TABLE (5). Response of two wheat cultivars yield components to bio-fertilizers in 2003/2004 (1^{st}) and 2004/2005 (2^{nd}) seasons.

Criteria / Treatments	Plant height (cm)		Spike length (cm)		No. of spiklets/spike		No. of grain/spike		Weight of 1000seed (gm)		No. of spikes/m^2	
Seasons	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}
Giza 168 Un-noculated	42.50	41.43	7.06	7.01	15.15	15.23	21.53	21.28	57.36	56.73	549.30	538.30
Rhizobactrein	60.87	61.62	8.07	8.17	16.12	15.99	27.33	27.43	73.54	72.67	879.00	784.60
Biogen	58.07	60.29	7.38	7.40	15.41	15.50	25.86	25.96	69.71	67.83	767.70	756.30
Sids 1 Un-noculated	33.98	32.75	5.24	5.19	14.20	14.28	12.88	12.97	45.89	45.29	263.30	245.70
Rhizobactrein	42.29	39.93	6.63	6.62	15.25	15.36	15.41	15.71	50.15	50 02	429.30	423.30
Biogen	44.91	44.09	7.08	7.38	15.44	15.44	20.54	20.90	57.01	57.15	562.70	556.30
LSD at 5%	1.36	0.52	0.89	0.11	0.18	0.14	0.39	0.12	1.06	1.40	18.07	69.29

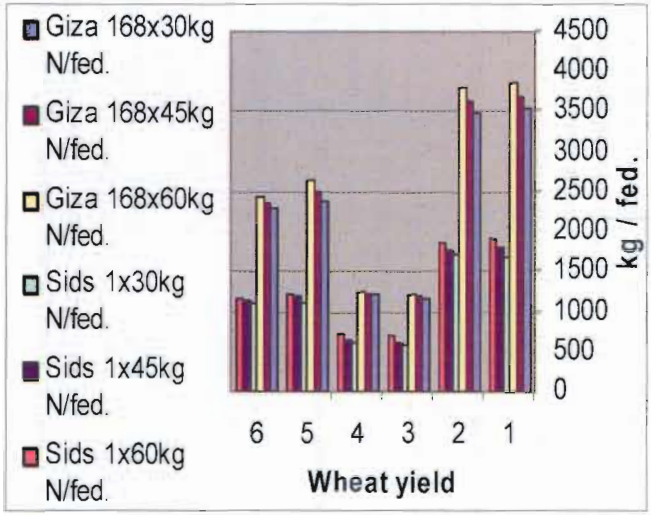

Fig (5). Response of two wheat cultivars yield to mineral nitrogen fertilizers on:

1- biological yield in the first season, 2-biological yield in the second season, 3- grain yield in the first season, 4- grain yield in the second season, 5-straw yield in the first season and 6 - straw yield in the second season .

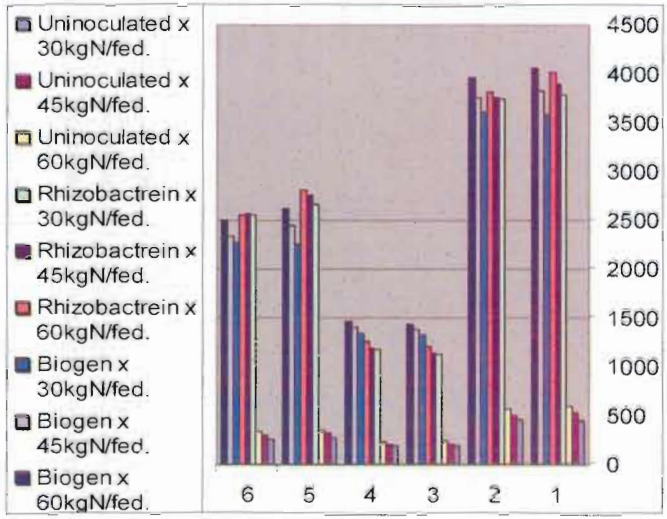

Fig (6). Response of wheat yield to mineral nitrogen fertilizers and biofertilizer on:

1-biological yield in the first season, 2-biological yield in the second season, 3-grain yield in the first season, 4-grain yield in the second season, 5-straw yield in the first season and 6-straw yield in the second season .

TABLE (6). Response of two wheat cultivars yield components to mineral nitrogen fertilizers in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Criteria Treatments	Plant height (cm)		Spike length (cm)		No. of spiklets/spike		No. of grain/spike		Weight of 1000seed (gm)		No. of spikes/m^2	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Giza 168 30kgN/fed.,	52.85	53.78	7.32	7.34	15.26	15.28	24.19	24.21	63.67	61.99	700 30	663.70
45kgN/fed.,	53.78	54.33	7.51	7.55	15.59	15.59	24.48	24.54	66.26	67.12	718.30	686.30
60kgN/fed.,	54.83	55.22	7.67	7.69	15.82	15.85	26.04	25.92	70.69	68.99	777.30	729.30
Sids 1 30kgN/fed.,	39.35	38.17	5.98	5.91	14 64	14.71	15.60	15.66	49.83	49.60	377.00	374.70
45kgN/fed.,	40.58	39.04	6.41	6.44	15.03	15.10	16.14	16.54	50.68	50.52	406.30	402.70
600kgN/fed.	41.23	39.55	6.56	6.60	15.23	15.27	17.08	17.38	52.53	52.33	472.00	448.00
LSD at 5%	Ns	0.24	Ns	0.06	0.10	0.06	0.01	0.09	3.01	1.13	22.04	Ns

Ns = not significant

TABLE (7). Response of wheat yield components to mineral nitrogen fertilizers and bio-fertilizer in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Criteria Treatments	Plant height (cm)		Spike length (cm)		No. of spiklets /spike		No. of grain/spike		No. of grain/spike		No. of spikes/m^2	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Un-noculated 30kg N/fed.	36.84	35.83	5.51	5.42	13.97	14.11	15.62	15.59	47.94	48.25	341.00	346.00
45 kg N/fed.	38.13	36.91	6.38	6.37	14.82	14.91	16.51	16.54	50.50	51.56	382.00	382.00
60 kg N/fed.	39.73	38.53	6.57	6.51	15.24	15.24	19.48	19.25	56.44	53.22	496.00	448.00
Rhizo. 30 kg N/fed.	50.43	50.28	7.30	7.29	15.58	15.56	20.98	21.02	61.12	60.75	634.50	575.50
45 kg N/fed.	51.93	50.95	7.31	7.42	15.70	15.68	21.23	21.81	61.54	61.12	648.00	602.00
60 kg N/fed.	52.39	51.09	7.44	7.48	15.78	15.79	21.89	21.88	67.87	62.19	680.00	634.50
Biogen 30 kg N/fed.	51.03	51.83	7.16	7.18	15.28	15.33	23.09	23.19	61.19	58.39	640.50	636.00
45 kg N/fed.	51.48	52.19	7.19	7.20	15.41	15.44	23.20	23.27	63.37	63.29	657.00	649.50
60 kg N/fed.	51.96	52.53	7.34	7.45	15.58	15.65	23.31	23.84	65.52	65.78	698.00	683.50
LSD at 5%	0.69	0.24	0.06	0.75	0.06	0.11	0.09	0.22	1.13	3.01	Ns	22.04

Ns = not significant

A-5 Second order interaction (Between three factors)

A-5-1 Effect of the interaction between cultivars, bio-fertilizer and mineral N fertilizer

The interaction between two cultivars, bio-fertilizer and mineral N fertilizer had significant effect on wheat yield and its components in the two growing seasons except those of spike length, biological yield and straw yield which were not significant in the first growing season. The variance analysis of yield components did not reveal any significant difference among the levels of N fertilizers (Table 8 and Figs 7a, b and c). Maximum values were obtained by inoculated wheat cultivar Giza 168 with Rhizobacterein and fertilized with 30 kg mineral N /fed. This situation indicating that bio-fertilizers save about 30 kg of mineral nitrogen fertilizer under South Sinai conditions.

TABLE (8). Response of two wheat cultivars yield components to biofertilizer and mineral nitrogen fertilizers in 2003/2004 (1^{st}) and 2004/2005 (2^{nd}) seasons.

Criteria			Plant height (cm)		Spike length (cm)		No. of spiklets/spike		No. of grain/spike		Weight of 1000seed (gm)		No. of spikes/m^2	
Seasons / Treatment			1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}
Giza 168	Un-inoculated	30kgN/fed.	40.41	40.16	6.64	6.59	14.38	14.55	19 44	19.34	51.44	52.59	482.00	486.00
		45kgN/fed.	42.25	41.08	7.18	7.16	15 29	15.35	20.23	20.19	55.41	58.12	507 00	512.00
		60kgN/fed.	44.85	43 04	7.37	7.26	15.79	15.78	24 91	24.31	65.23	59.48	659.00	617 00
Sids 1		30kgN/fed	33.26	31.50	4 37	4 24	13.57	13.66	11 79	11.85	44.43	43 90	200 00	206.00
		45kgN/fed.	34.01	32.74	5 57	5.58	14.34	14 47	12.78	12.88	45.59	45.00	257.00	252.00
		60kgN/fed.	34.61	34.01	5.77	5 76	14.69	14.70	14.06	14.19	47 65	46.96	333.00	279 00
Giza 168	Rhizobactrein	30kgN/fed.	60.39	61.17	8.05	8.15	16.10	15.96	27.28	27.36	72.83	72.24	874.00	762 00
		45kgN/fed.	61.09	61 70	8.06	8.17	16.12	15.98	27 32	27.46	73.29	72 66	879.00	789.00
		60kgN/fed.	61 15	61.98	8.10	8.19	16.14	16.03	27 38	27.47	74.50	73.13	884 00	803 00
Sids 1		30kgN/fed.	40.47	39.39	6.55	6 43	15.06	15.15	14.69	14 68	49.41	49.25	395 00	389.00
		45kgN/fed	42.76	40.19	6.56	6 66	15.28	15 38	15 14	16.16	49 79	49 57	417.00	415.00
		60kgN/fed.	43.64	40 20	6.78	6.77	15.42	15.54	16 40	16 28	51.25	51 25	476 00	466.00
Giza 168	Biogen	30kgN/fed.	57.74	60 02	7 28	7.29	15 29	15.33	25 87	25 94	66.73	61 13	745 00	743.00
		45kgN/fed.	57 99	60.21	7 29	7.31	15.36	15 43	25.89	25.96	70.07	69 57	769 00	758.00
		60kgN/fed.	58.48	60 64	7.56	7 61	15.57	15 73	25 83	25.99	72.34	72 78	789 00	768.00
Sids 1		30kgN/fed.	44.32	43.63	7 04	7.06	15.28	15.32	20.32	20.44	55.66	55.66	536.00	529.00
		45kgN/fed	44 97	44 18	7.10	7.09	15 46	15 45	20 51	20.58	56.67	57 00	545 00	541 00
		60kgN/fed	45.45	44 45	7.12	7 28	15.58	15.56	20.79	21.68	58 69	58.78	607 00	599 00
LSD at 5 %			0 69	0 24	Ns	0 06	0 10	0.06	0.22	0 01	3.01	1.13	22 04	41 22

Ns = not significant

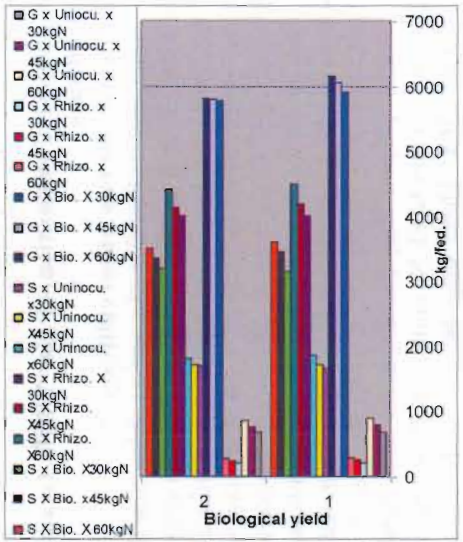

Fig (7a). Response of two wheat cultivars yield to biofertilizer and mineral nitrogen fertilizers on:

1-biological yield in the first season

2-biological yield in the second season.

G: Giza 168 , S: Sids 1

1: 2003/2004 (1st), 2: 2004/2005 (2nd)

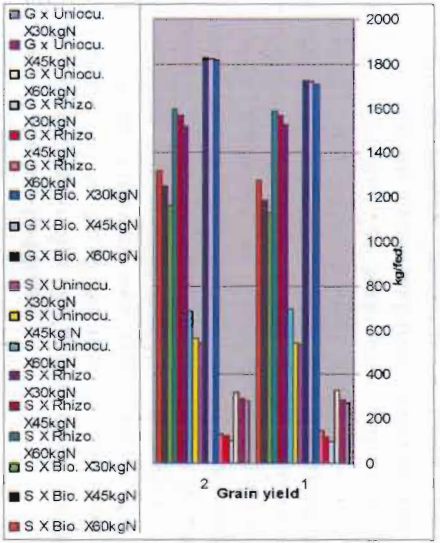

Fig (7 b). Response of two wheat cultivars yield to biofertilizer and mineral nitrogen fertilizers on:

1-grain yield in the first season.

2-grain yield in the second season.

G: Giza 168 , S: Sids 1

1 : 2003/2004 (1st), 2: 2004/2005 (2nd)

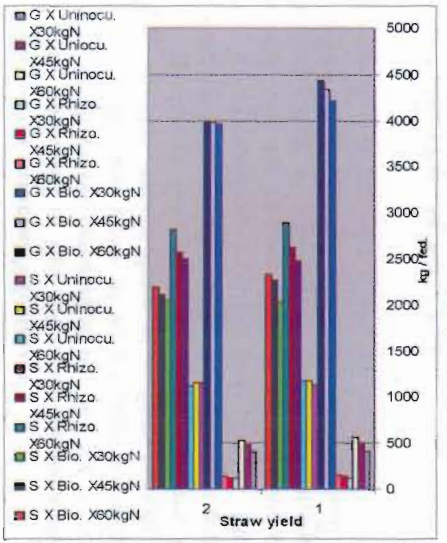

Fig (7c). Response of two wheat cultivars yield components to biofertilizer and mineral nitrogen fertilizers on:

1-straw yield in the first season.

2- straw yield in the second season.

G: Giza 168 , S: Sids 1

1 : 2003/2004 (1st) , 2: 2004/2005 (2nd)

B- Chemical Composition of the Whole Grain and Straw of Wheat Cultivars

B-1- Effect of the two wheat cultivars

Data reported in figs (8a and b) show that the percentage of K, Na, K/Na ratio, N, and protein content of the two cultivars in the two growing seasons were significant. The trend of the chemical components of the two cultivars were similar to those of grain and straw indicating the superiority percentage of K, K/Na ratio, N, and protein in tolerant cultivar i.e., Giza 168 to salinity and minority content of the aforementioned components in Sids 1, on the other hand, percentage of sodium decreased significantly in the two cultivars. Obtained results are in accordance with the findings of Astaraei and Chauhan (1994). They found that the K, content in straw decreased with salinity. In the other hand, Na content in straw and grain were higher in Sids-1 than Giza 168. These may be due to the reduction of potassium and increase of the sodium concentration at the same time by salinity (Drihem and Pilbeam, 2002).

B-2 Effect of the bio-fertilizers

Data indicated in figs (9 a and b) show that the effect of bio-fertilizer on percentage of K, Na, K/Na ratio, N, and protein content in grain and straw of wheat cultivars was significant in the two growing seasons. Rhizobacterein was superior than Biogen in grain and straw of wheat in all characters in the two growing seasons except K content in grain which was not significant in the first growing season. These may be due to the supply of more plant hormones by Rhizobacterein (*Azotobacter chroococcum* + *Azospirillum brasilense*) than Biogen (*Azotobacter chroococcum*) alone. The straw and grain analyses reveal that the uptake of the important nutrients of N and protein were improved by varying degrees. Such improvement in the chemical composition of both grain and straw has an impact on their nutritional value for human and animal consumption. Though the application of bio-fertilizers proved superiority compared with other sources in terms of high yield and plant uptake of essential elements.

B-3 Effect of the mineral N fertilizer

Data indicated in figs (10 a and b) show that the effect of mineral nitrogen fertilizer on percentage of K, Na, K/Na ratio, N, and protein content in grain and straw of wheat cultivars were significant in the two growing seasons, except those of sodium content in grain in the second season. Increasing nitrogen fertilizer levels from 30 up to 60 kg N /fed. increased the percentage of K, K/Na, N, protein content in the two growing seasons except sodium content in both seasons. McNeal and Davis (1954) illustrated that the increase of N content in grain due to reduction of zink requirement such as building different plant organs. Wuest and Cassman (1992) suggested that while the availability of soil N and water may often

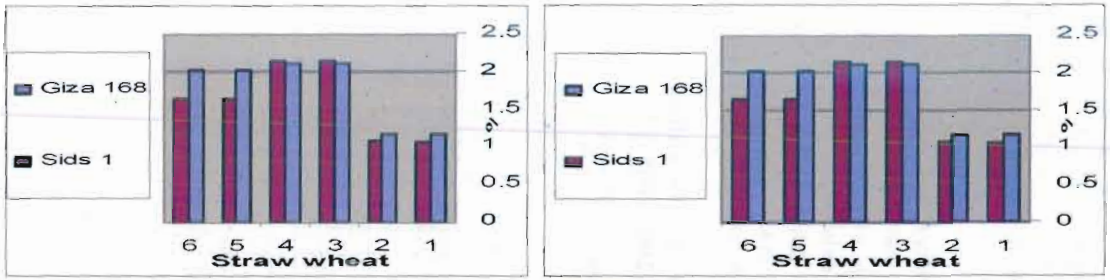

Fig. (8a). Response of grain and straw chemical content of two cultivars on percentage of:
1-K in the first season, 2- K in the second season, 3- Na in the first season,
4- Na in the second season, 5- N in the first season, 6-N in the second season.

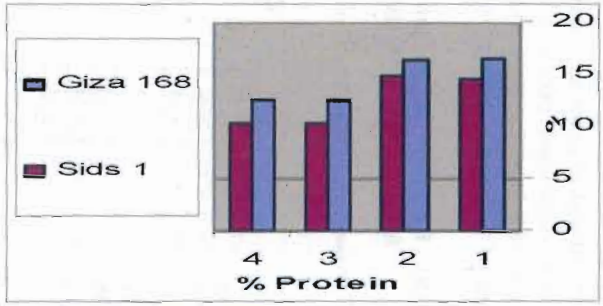

Fig. (8b). Response of grain and straw chemical content of two cultivars on percentage of:
1-protein of grain in the first season, 2- protein of grain in the second season,
3- protein of straw in the first season and 4- protein of straw in the second season

constrain preflowering N uptake, application of N near flowering increased N uptake, grain protein content, and grain protein concentrations. Hence, increasing grain protein by applying higher fertilizer N rates is relatively inefficient. On the other hand, Amer (1999) found that the salinity reduced K/Na ratio in grain and straw of wheat. Drihem and Pilbeam (2002) found that the concentrations of potassium K decreased under salinity conditions (irrigation water's salinity level is 6868 ppm) and was generally higher with N supply, whereas, concentrations of Na were higher with salinity and lower with N supply. It could be concluded that the inhibition of yield in wheat cultivars under saline conditions is probably due to the effect of salinity on grain and straw.

B-4 First order interactions

B-4-1 Effect of the interaction between bio-fertilizer and cultivars

Data indicated in tables (9 a and b) show that the response of the two wheat cultivars to bio-fertilizer on the percentage of K, Na, K/Na ratio, N, and protein content in grain and straw of wheat cultivars in the two growing seasons, was significant except K content of grain in the first growing season. Giza 168 inoculated by Rhizobacterein was higher in all chemical percentages of K, Na, K/Na ratio, N, and protein content in grain and straw of wheat .

TABLE (9). Response of chemical content of two cultivars to bio-fertilizers in 2003/2004 (1^{st}) and 2004/2005 (2^{nd}) seasons.

Chemicals Criteria	Potassium content		Sodium content		K /Na ratio		Nitrogen content		Protein content %	
Seasons	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}
Grain										
Giza 168 Un-inoculated	0 67	0.69	0.59	0.58	1.14	1.18	2.51	2 42	15.71	15 13
Rhizobactrein	0 71	0.72	0.46	0 45	1.55	1.58	2.74	2.75	17.12	17.18
Biogen	0.69	0.69	0.48	0.50	1.43	1.39	2.69	2 59	16.79	16.21
Sids 1 Un-inoculated	0.63	0.62	0.54	0.53	1.16	1.16	2.21	2.04	13.79	12 77
Rhizobactrein	0.65	0.63	0.53	0.54	1.22	1.17	2.35	2.48	14.70	15.50
Biogen	0.66	0.66	0.54	0 55	1.23	1.19	2.42	2 42	15.13	15.14
LSD at 5%	Ns	0.02	0.01	0.07	--------	--------	0.01	0.03	0.38	0.146
Straw										
Giza 168 Un-inoculated	1.08	1.08	2.16	2.150	0.50	0.50	1.81	1.81	11.33	11.33
Rhizobactrein	1.28	1.28	1.96	1.940	0.65	0.66	2.14	2.14	13.38	13.36
Biogen	1.17	1.16	2.34	2.317	0.49	0.50	2.09	2 08	13.05	13.02
Sids 1 Un-inoculated	1.01	1.04	2.13	2.130	0.47	0.49	1.45	1.45	9.05	9.04
Rhizobactrein	1.07	1.07	2.08	2.080	0.51	0.51	1.64	1.64	10.24	10.24
Biogen	1.13	1.14	2.09	2.090	0.54	0.55	1.85	1.84	11.54	11.51
LSD at 5%	0.05	0.02	0.04	0.0852	-------	-------	0.02	0 01	0.03	0 06

Ns = not significant

B-4-2 Effect of the interaction between cultivars and mineral N fertilizer

Data indicated in tables (10 a and b) show that the response of the two cultivars to mineral N fertilizer on the percentage of K, Na, K/Na ratio, N, and protein content in grain and straw of wheat cultivars in the two growing seasons, was significant except those of K content of grain in the two growing seasons, and of straw in the second season. All chemical K, Na, K/Na ratio, N, and protein content were increased in the tissues of Giza-168 fertilized by 60 kg N / fed. in both seasons, except those of Na content.

B-4-3 Effect of the interaction between bio-fertilizer and mineral N fertilizer

Data indicated in tables (11a and b) show that the effect of interaction between bio-fertilizer and mineral N fertilizer on the percentage of K, Na, K/Na ratio, N, and protein content in grain and straw of wheat cultivars in the two growing seasons, was significant, except K content of grain in the second season, and for straw in both seasons. Maximum values of the aforementioned criteria were obtained in the tissue of wheat grain fertilized by 60 kg N/ fed. and inoculated with Rhizobacterein. These results may be due to the increase of nitrogen content in grain as a zink required additional synthesis and accumulation of proteins in addition to hormones and nitrogen supply by Rhizobacterein.

B-5 Second order of interaction

Effect of the interaction between cultivars, bio-fertilizer and mineral N fertilizer

Data in tables (12 a and b) show that the effect of the interaction between two wheat cultivars, bio-fertilizer and mineral N fertilizer on the percentage of K, Na, K/Na ratio, N, and protein content in grain and straw of two wheat cultivars were significant in the two seasons, except K content of grain in the second season and in straw in the first season. The promising treatment was inoculated Giza 168 cultivar by Rhizobacterein and fertilized with 60 kg N/ fed. It could be concluded that inoculation wheat cultivar Giza 168 with Rhizobacterein saves half of mineral nitrogen fertilizer dose coinciding with producing high yield, yield attributes and chemical composition under South Sinai region. Therefore, using low levels of mineral fertilizer i.e., 30 kg mineral N/fed. is enough to give good grain yield and saving money, protecting the environment against to the pollution.

In general, Rhizobacterein + ½ dose of mineral N (30 kg N/fed.) in Giza 168, cultivar encourage the farmers to use bio-fertilizer and decrease mineral nitrogen levels, hence save money, decreased the pollution to produce high grain yield.

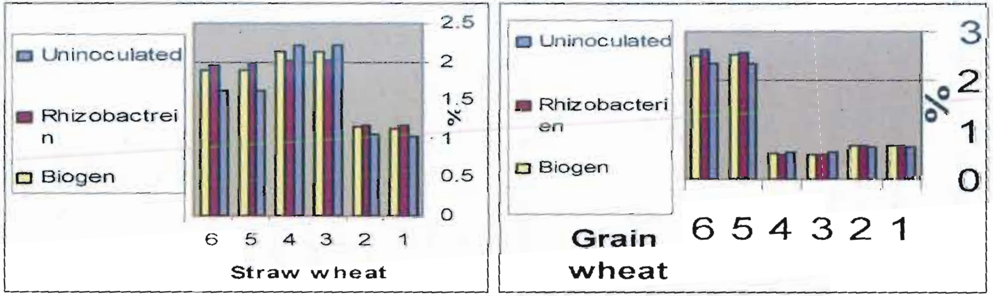

Fig (9 a). Response of grain and straw chemical content to biofertilizers on percentage of:
1-K in the first season, 2- K in the second season, 3- Na in the first season,
4- Na in the second season, 5- N in the first season, 6-N in the second season.

Fig (9b). Response of grain and straw chemical content to biofertilizers on percentage of:
1-protein of grain in the first season, 2- protein of grain in the second season,
3- protein of straw in the first season and 4- protein of straw in the second season.

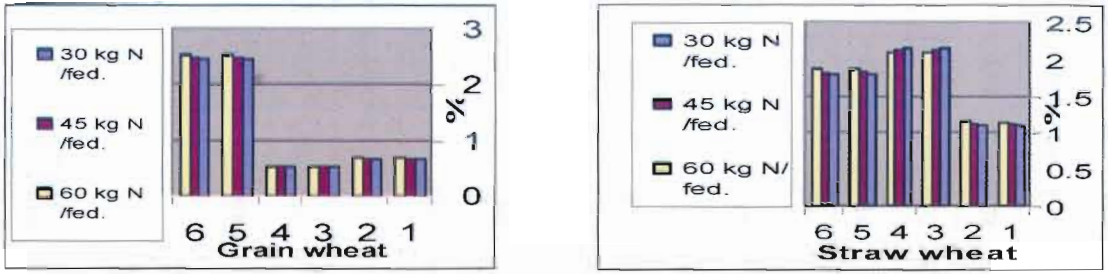

Fig (10a). Response of grain and straw chemical content to mineral nitrogen fertilizers on percentage of:
1-K in the first season, 2- K in the second season, 3- Na in the first season,
4- Na in the second season, 5- N in the first season, 6-N in the second season.

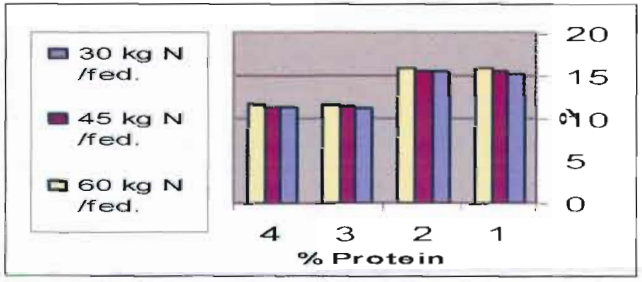

Fig (10b). Response of grain and straw chemical content to mineral nitrogen fertilizers on percentage of:
1-protein of grain in the first season, 2- protein of grain in the second season,
3- protein of straw in the first season and 4- protein of straw in the second season.

TABLE (10). Response of chemical content of two cultivars to mineral nitrogen fertilizers in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Chemicals Criteria	Potassium content		Sodium content		K /Na ratio		Nitrogen content		Protein content %	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Grain										
Giza 168 30kg N/fed.	0.68	0.68	0.52	0.52	1.29	1.31	2.61	2.52	16.29	15.74
45kg N/fed.	0.69	0.70	0.50	0.51	1.39	1.39	2.62	2.63	16.34	16.41
60kg N/fed.	0.70	0.71	0.51	0.50	1.38	1.42	2.72	2.62	16.98	16.37
Sids 1 30kg N/fed.	0.63	0.62	0.53	0.56	1.18	1.12	2.29	2.16	15.74	13.50
45kg N/fed.	0.65	0.64	0.54	0.54	1.21	1.17	2.33	2.34	16.41	14.63
600kgN/fed.	0.66	0.65	0.54	0.53	1.22	1.22	2.35	2.45	16.37	15.29
LSDat5%	Ns	Ns	0.02	0.04	------	------	0.01	0.01	0.07	0.07
Straw										
Giza 168 30kg N/fed.	1.16	1.16	2.15	2.15	0.54	0.55	1.97	1.97	12.30	12.34
45kg N/fed.	1.17	1.17	2.15	2.13	0.55	0.55	2.01	2.01	12.57	12.54
60kg N/fed.	1.20	1.19	2.16	2.13	0.56	0.56	2.06	2.05	12.87	12.82
Sids 1 30kg N/fed.	1.06	1.07	2.05	2.05	0.52	0.52	1.62	1.62	10.11	10.12
45kg N/fed.	1.07	1.08	2.12	2.12	0.51	0.51	1.64	1.63	10.22	10.21
600kgN/fed.	1.08	1.10	2.13	2.13	0.51	0.52	1.68	1.68	10.49	10.48
LSDat5%	0.02	Ns	0.02	0.02	------	------	0.02	0.014	0.10	0.08

Ns = not significant

TABLE (11). Response of chemical content to mineral nitrogen fertilizers and bio-fertilizers in 2003/2004 (1st) and 2004/2005 (2nd) seasons.

Chemicals Criteria	Potassium content		Sodium content		K /Na ratio		Nitrogen content		Protein content %	
Seasons	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Grain										
Un-noculated 30kgN/fed.	0.63	0.64	0.54	0.53	1.18	1.21	2.31	1.92	14.42	11.99
45 kgN/fed.	0 65	0.66	0.57	0.56	1.15	1.18	2 32	2.32	14.48	14.52
60 kgN/fed.	0.67	0.66	0.59	0.59	1.12	1.13	2.46	2.45	15.35	15.33
Rhizo. 30 kgN/fed.	0.67	0.66	0.53	0.54	1.26	1.23	2.54	2.56	15.87	15.99
45 kgN/fed.	0.68	0.67	0.48	0.49	1.41	1.36	2.55	2.57	15.96	16.05
60 kgN/fed.	0.69	0.69	0.47	0.46	1.47	1.48	2.58	2.72	16.11	16.98
Biogeu 30 kgN/fed.	0.66	0.66	0.52	0.53	1.28	1.26	2.51	2.54	15.65	15.87
45 kgN/fed.	0.67	0.68	0.52	0.53	1.31	1.29	2.55	2.56	15.93	15.98
60 kgN/fed.	0.68	0.69	0.50	0.53	1.37	1.30	2.57	2.43	16.07	15.17
LSD at5%	0.01	Ns	0.02	0.04	--------	---------	0.01	0.01	0.07	0 07
Straw										
Un-noculated 30kgN/fed.	1.03	1.04	2.14	2.13	0.48	0.49	1.60	1.60	10.01	10 03
45 kgN/fed.	1.05	1.06	2.14	2.14	0.49	0.49	1.62	1.62	10 13	10.13
60 kgN/fed.	0.71	1.08	2.15	2.14	0.33	0.50	1.67	1 66	10.42	10.39
Rhizo. 30 kgN/fed.	1.16	1.16	1.98	1.97	0 59	0.59	1 93	1.92	12.04	12.03
45 kgN/fed.	1.17	1.18	2.04	2.03	0.58	0.58	1.97	1.96	12.31	12.26
60 kgN/fed.	1.19	1.19	2.04	2.04	0.59	0.58	2.07	2.00	12.54	12.51
Biogen 30 kgN/fed.	1.14	1.14	2.18	2.17	0.52	0.52	1.85	1.86	11.56	11.63
45 kgN/fed.	1.14	1 15	2.22	2.21	0.52	0.52	1.88	1.88	11.76	11 73
60 kgN/fed.	1.17	1.17	2.24	2.23	0.52	0.53	1.94	1.93	12 10	12 04
LSD at5%	Ns	Ns	0.02	0.02	---------	---------	0.02	0.014	0.10	0.08

Ns = not significant

TABLE (12). Response of chemical content of two cultivars to bio-fertilizers and mineral nitrogen fertilizers in2003/2004 (1st) and 2004/2005 (2nd) seasons.

Criteria			Potassium content		Sodium content		K /Na ratio		Nitrogen content		Protein content %	
Seasons / Treatment			1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Grain												
Giza 168	Un-inoculated	30kgN/fed	0.65	0.67	0.62	0.61	1.05	1.09	2.42	2.15	15.12	13.41
		45kgN/fed	0.67	0.69	0.59	0.59	1.14	1.17	2.44	2.43	15.23	15.21
		60kgN/fed	0.69	0.70	0.55	0.54	1.25	1.29	2.68	2.68	16.78	16.77
Sids 1		30kgN/fed	0.61	0.60	0.57	0.57	1.07	1.05	2.19	1.69	13.72	10.59
		45kgN/fed	0.63	0.62	0.54	0.52	1.17	1.19	2.19	2.21	13.72	13.82
		60kgN/fed	0.64	0.63	0.52	0.51	1.23	1.24	2.23	2.22	13.92	13.89
Giza 168	Rhizobactrein	30kgN/fed	0.70	0.70	0.43	0.50	1.63	1.40	2.73	2.74	17.03	17.09
		45kgN/fed	0.72	0.72	0.44	0.44	1.64	1.64	2.73	2.74	17.07	17.15
		60kgN/fed	0.72	0.73	0.45	0.42	1.60	1.74	2.76	2.77	17.26	17.29
Sids 1		30kgN/fed	0.63	0.62	0.51	0.57	1.24	1.09	2.28	2.38	14.28	14.89
		45kgN/fed	0.65	0.63	0.53	0.55	1.23	1.15	2.38	2.39	14.87	14.94
		60kgN/fed	0.66	0.65	0.55	0.51	1.20	1.28	2.39	2.67	14.96	16.66
Giza 168	Biogen	30kgN/fed	0.68	0.68	0.51	0.53	1.33	1.28	2.67	2.68	16.72	16.73
		45kgN/fed	0.69	0.70	0.49	0.49	1.41	1.43	2.68	2.69	16.74	16.85
		60kgN/fed	0.69	0.71	0.45	0.48	1.53	1.48	2.70	2.41	16.89	15.04
Sids 1		30kgN/fed	0.65	0.65	0.55	0.58	1.18	1.12	2.40	2.40	15.02	15.02
		45kgN/fed	0.66	0.66	0.54	0.56	1.22	1.18	2.42	2.42	15.13	15.11
		60kgN/fed	0.68	0.67	0.53	0.53	1.28	1.26	2.44	2.45	15.25	15.11
LSD at 5 %			0.01	Ns	0.02	0.04	------	--------	0.01	0.01	0.07	0.07
Straw												
Giza 168	Un-inoculated	30kgN/fed	1.06	1.05	2.17	2.16	0.49	0.486	1.793	1.799	11.21	11.24
		45kgN/fed	1.08	1.07	2.16	2.15	0.50	0.50	1.80	1.80	11.24	11.26
		60kgN/fed	1.11	1.10	2.14	2.13	0.52	0.52	1.85	1.84	11.53	11.48
Sids 1		30kgN/fed	1.00	1.02	2.14	2.14	0.47	0.48	1.41	1.41	8.82	8.81
		45kgN/fed	1.01	1.04	2.13	2.14	0.47	0.49	1.44	1.44	9.02	9.01
		60kgN/fed	1.01	1.05	2.11	2.12	0.48	0.50	1.49	1.49	9.31	9.31
Giza 168	Rhizobactrein	30kgN/fed	1.26	1.27	1.97	1.96	0.64	0.65	2.09	2.10	13.06	13.15
		45kgN/fed	1.28	1.28	1.96	1.95	0.65	0.66	2.14	2.13	13.38	13.31
		60kgN/fed	1.30	1.29	1.96	1.95	0.66	0.662	2.19	2.18	13.71	13.62
Sids 1		30kgN/fed	1.05	1.05	2.14	2.13	0.49	0.50	1.61	1.62	10.08	10.11
		45kgN/fed	1.07	1.07	2.12	2.12	0.51	0.51	1.62	1.62	10.14	10.15
		60kgN/fed	1.09	1.09	1.98	1.97	0.55	0.55	1.68	1.68	10.49	10.47
Giza 168	Biogen	30kgN/fed	1.15	1.14	2.36	2.34	0.49	0.49	2.02	2.02	12.64	12.64
		45kgN/fed	1.16	1.16	2.33	2.31	0.50	0.50	2.10	2.09	13.11	13.05
		60kgN/fed	1.19	1.19	2.33	2.30	0.51	0.52	2.14	2.14	13.39	13.36
Sids 1		30kgN/fed	1.12	1.13	2.12	2.11	0.53	0.54	1.83	1.83	11.44	11.41
		45kgN/fed	1.13	1.14	2.11	2.10	0.54	0.54	1.84	1.83	11.51	11.46
		60kgN/fed	1.15	1.16	2.03	2.07	0.57	0.56	1.87	1.86	11.68	11.64
LSD at 5 %			Ns	0.01	0.02	0.02	-------	-------	0.02	0.01	0.10	0.08

Whereas, Ns = not significant

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استجابة صنفين من القمح (*Triticum aestivum* L.) للتسميد النتروجيني المعدني والحيوي بمحافظة جنوب سيناء فى مصر

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تم إجراء تجربتين حقليتين بمحطة مركز بحوث الصحراء بوادى سدر بمحافظة جنوب سيناء خلال موسمين زراعيين متتاليين ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥ وذلك لدراسة تأثير ثلاث مستويات مختلفة من السماد النتروجينى المعدني (٣٠و ٤٥و٦٠ كجم نتروجين / فدان على صورة كبريتات امونيوم ٢٠,٦%) مع نوعيين مختلفين من الأسمدة الحيوية التجارية ريزوباكترين (خليط من ازوتوباكتر كروكوم + ازوسبيريليم براسيلينز) وبيوجين (ازوتوباكتر كروكوم) مقارنة بغير المعامل على صنفين من القمح جيزة ١٦٨وسدس ١ والتي تم ريهم من بئر بالمنطقة والتي تصل نسبة ملوحتة ٦٨٦٨ جزء في المليون عن طريق شبكة ري مجهزة. أوضحت الدراسة النتائج التالية:

١- تفوق صنف جيزة ١٦٨ على صنف سدس ١ في صفات المحصول ومكوناتة في كلا الموسمين.
٢- تفوق التسميد الحيوي (ريزوباكترين) على بيوجين في صفات المحصول ومكوناتة في كلا الموسمين.
٣- زاد محصول القمح ومكوناتة معنويا بزيادة التسميد النتروجينى المعدني من ٣٠ كجم حتى ٦٠ كجم نتروجين / فدان في كلا الموسمين.
٤- زاد محصول القمح صنف جيزة ١٦٨ ومكوناتة باستخدام السماد الحيوي (الريزوباكترين) في كلا الموسمين.
٥- كان التفاعل بين التسميد المعدني النتروجيني وصنفي القمح معنويا في بعض صفات المحصول ومكوناتة حيث كانت أفضل معاملة هي صنف القمح جيزة ١٦٨ والمسمد بالمعدل المرتفع من السماد المعدني النتروجينى (٦٠ كجم نتروجين / فدان على صورة كبريتات امونيوم) في كلا الموسمين.
٦- كان التفاعل بين نوعى التسميد المعدني والحيوي معنويا في صفات المحصول ومكوناتة حيث كانت أفضل معاملة بين السماد الحيوي (الريزوباكترين) والسماد المعدني النتروجينى بمعدل ٣٠ كجم / فدان في كلا الموسمين.
٧- كان التفاعل بين التسميد المعدني x الحيوي x الأصناف معنويا في صفات المحصول ومكوناتة حيث كانت أفضل معاملة هي صنف القمح جيزة ١٦٨ والمعامل بالسماد الحيوي (الريزوباكترين) والمسمد بمعدل ٣٠ كجم نتروجين / فدان في كلا الموسمين .
٨- زادت نسبة البوتاسيوم ونسبة البوتاسيوم / الصوديوم و النتروجين و البروتين وقلت نسبة الصوديوم فى حبوب وقش القمح صنف جيزة ١٦٨ والمعامل بالسماد الحيوي الريزوباكترين وبزيادة التسميد النتروجينى بمفرديهما و أيضا التفاعل بينهما في كلا الموسمين.
٩- ينصح في الاراضى المتأثرة بالأملاح كما في منطقة راس سدر بمحافظة جنوب سيناء معاملة صنف القمح جيزة ١٦٨ بالريزوباكترين (كمثبت لازوت الهواء الجوى) الذي يؤدى إلى تقليل جرعة التسميد المعدني النتروجيني إلى النصف وبالتالي إعطاء محصول جيد بالإضافة إلى تقليل التلوث وزيادة العائد الأقتصادى للمزارعين.