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EVALUATION THE EFFICIENCY OF SEEDING RATE AND INOCULATION WITH SOME DIAZOTRPHES ON GROWTH, YIELD AND PROTEIN CONTENT OF WHEAT CROP (*Triticum aestivum* L.) GROWN IN SANDY SOILS UNDER GRADED LEVELS OF N-FERTILIZER

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ABSTRACT

Two field experiments were carried out in Ismailia Agricultural Research Station, Agricultural Research Center during 2002/2003 and 2003/2004 to study the effect of seeding rates (60 and 80 kg seeds/fed.) and inoculation with free living (*Azotobacter*) and associative (*Azospirillum*) N_2-fixers in a form of single or dual inoculum together with two rates on N-fertilizer (60 and 90 kg N/fed), in addition of treatment received 120 kg N/fed only on growth, yield and yield components of wheat plants (Giza 168) grown in sandy soils. A split plot design with three replications was used. The results of the combined analysis of the two growing seasons 2002/2003 and 2003/2004 indiceted that :-

1- Seeding rate of 60 kg seed/fed. significantly increased numbers of tillers/plant, spike length, number of grains/spike, 1000-grain weight, grain yield and total protein (kg/fed.) while, 80 kg seed/fed. significantly increased plant height, number of spikes/m^2, straw yield and protein percent.

2- Results also revealed that no significant differences could be observed due to inoculation with both *Azotobacter* or *Azospirillum* on all the tested parameters. However, *Azotobacter* gave values higher than *Azospirillum*, but the values didn't reach to the level of significancy. Taking biofertilization with mixed culture of *Azotobacter* and *Azospirillum* together with 90 kg N/fed into account, results showed an increase in grain yield by about 2.7% over mineral N application (120 kg N/fed). Such results indicated that biofertilization could save at least 25% of recommended nitrogen, besides its role in reducing pollution associated with mineral nitrogen application.

3- The interaction between seeding rate and biofertilization clearly indicated that seed rate of 60 kg N/fed when inoculated with mixture of free and associative N_2-fixers was superior in achieving yield and yield components, grain yield and protein yield and was more efficient in increasing total N recovery.

INTRODUCTION

Wheat crop is one of the most important cereal crops in Egypt. Due to tremendous increasing in population in Egypt, its production is insufficient to meet local consumption. In this respect, increasing cultivated area as well as increasing production per unit area are main objectives for reducing the gap between wheat production and consumption. Seeding rates can be considered among the most important cultural practices for increasing wheat productivity. Hegazi *et al.* (1982) found that increasing the seed rate has significantly reduced number of kernels/spike and spike length. Yakout *et al.* (1998) reported that number of tillers/plant, spike length, number of

grains/spike and 1000-grain weight, as well as grain protein content % were decreased significantly by increasing seeding rates. But increasing seeding rates increased significantly plant height and straw yield up to the highest seeding rate 80 kg/fed., whereas 60 kg seeds/fed resulted the highest number of spikes/m^2 and grain yield/fed. Hamada *et al.* (2001) found that increasing seeding rates from 40 to 60 kg seeds/fed gave the tallest plants, highest number of spikes/m^2 and straw yield were produced by seeding rate of 60 kg/fed., while number of grains/spike and 1000-grain weight were significantly decreased as the seeding rates increased up to 60 kg/fed. Abd-Alla (2002) showed that by using four seeding rates (50, 60, 70 and 80 kg seeds/fed.) significantly increased number of spikes/m2 and straw and grain yields/fed., but decreased spike length, number of grains/spike and 1000-grain weight. El- Nady (2003) concluded that increasing seeding rates from 45 to 75 kg/fed significantly decreased spike length and weight of 1000-grain, while significantly increased number of spikes/m^2 and grain and straw yields/fed. On the other hand, plant height, number of tillers/m^2 and number of grains/spike were not affected. Saleh (2003) demonstrated that spike length and number of grains/spike were significantly decreased by increasing seeding rates from 60 to 120 kg/ha, whereas, number of spikes/m^2 and grain yield/ha were significantly increased. On the other hand, plant height and 1000-grain weight were not affected. El-Wakil and Abd-Alla (2004) found that increasing seeding rate up to 75 kg/fed significantly increased plant height, spike length, number of grains/spike, number of spikes/m^2 and grains and total yield/fed, but significantly decreased 1000-grain weight, while, straw yield/fed was not affected significantly.

Intensive crop cultivation requires huge amount of nitrogen fertilizers which are not only, very expensive, but also cause pollution, to agroeco-systems. So, the use of nitrogen fixing bacteria as biofertilizer can reduce the use of chemical fertilizers, decrease environmental pollution, save money and keep high productivity of crops that satisfy the demand of the growing production.

Recently, many investigators have used biofertilizers from bacteria origin successfully to minimize the dose of nitrogen fertilizers. Abdel Aziz *et al.* (1989) and Omar *et al.* (1991) showed that associative N_2-fixing bacteria were effective in reducing N fertilizer for wheat. Patra *et al.* (1989) using *Azotobacter* or *Azospirillum* inoculation and concluded that using 40 kg N/ha + *Azotobacter* were the most economic fertilizer application for obtaining the highest wheat grain yield. Hussein *et al.* (1993) found that inoculation with *Azospirillum brasilense* of wheat not only increased grain yield, but also improve grain quality. Saber (1993) concluded that using the biofertilizer Microbin (a set of P dissolving and N_2-fixing bacteria) as seed dressing in field crops led to significant reduction in the rates of mineral fertilizers. El-Baggory *et al.* (1996) in a trail using some biofertilizers including Phosphorin and Microbin. They found that the results emphasized the effective action of biofertilizer in reducing the normal rate of N fertilizer by about 20 kg N/fed for wheat. Milkees *et al.* (1996) reported that biofertilization with mixture of N_2-fixing bacteria (*Azospirillum, Bacillus* and *Azotobacter*) added to the soil with different levels of mineral fertilizer for wheat plants, could compensate

considerable parts of mineral nitrogen fertilizer by about 2/3 and 1/3 of the recommended nitrogen in old and new lands, respectively. Bedaiwi *et al.* (1997) used four biofertilizers (Nitrobin, Microbin, Cerealin and Azottin, along with Ascobin) 1993/94 and 1994/95. They showed that biofertilization could compensate 30-40% of the recommended nitrogen, especially in new lands. Although no significant differences could be detected among the four biofertilizers, Azottin and Nitrobin proved to perform the highest, either in old or new lands. The effect of Ascobin was significant giving about 6% in fertile soil as compared to 19% in sandy soil. Sharaan and Abd El-Sami (1999) studied the effect of Microbin fertilizer under different rates of N-fertilizer (25, 50 and 75 kg N/fed). They concluded that the high rate of N-fertilizer combined with inoculation led to a significant increase in number of spikes/m^2, spike length, number of grains/spike, 1000-grain weight and grain yield. El-Baggory *et al.* (2001) studied four local N_2-fixing biofertilizers (Nitrobin, Rhizobacterin, Microbin and Cerealin) under two N levels (60 and 120 kg N/fed) in 1997/98. The obtained results indicated the beneficial effect of performing biofertilization with N fertilizer on improving grain yield and reducing the required mineral N fertilizer by about 50%. Cerealin was the most effective one followed by Microbin then Rhizobacterin, while Nitrobin was the least one. The effect of N or N x biofertilizers on straw yield was less than that obtained with grain yield. Moreover, biofertilization was more effective with 120 kg N than that with 60 kg N/fed. Contrary to that found in grain yield, N and N x biofertilizers significantly increased N content (%) and nitrogen uptake (kg/fed) in grain and straw yields.

With respect to nitrogen, Saleh (2003) indicated that increasing nitrogen levels from 69 kg N/ha up to 207 kg N/ha significantly increased plant height, spike length, number of grains/spike, 1000-grain weight, number of spikes/m2 and grain yield/ha. El-Wakil *et al.* (2004) demonstrated that increasing nitrogen fertilizer level from 60 kg N/fed up to 90 kg N/fed significantly increased plant height, spike length, number of spikes/plant, number of grains/spike, number of spikes/m^2, 1000-grain weight and grain and straw yields/fed.

The purpose of this work was to study the effect of seeding rates and biofertilizers with mineral nitrogen on growth, yield, yield components and grain protein content of wheat in sandy soils, under sprinkler irrigation system.

MATERIALS AND METHODS

Two field experiments were conducted in Ismailia Agricultural Research Station during 2002/2003 and 2003/2004 seasons to study the effect of two seeding rates i.e., 60 and 80 kg seeds/fed of wheat (variety Giza 168) and two N_2-fixing biofertilizers, being *Azotobacter chroococcum* and *Azospirillum* spp. with nitrogen levels i.e., 60, 90 and 120 kg N/fed on growth yield and yield components of wheat plants.

Physical properties and chemical analysis of the soil of experiments are given in Table (1).

Table (1): Mechanical and chemical analysis of the soil before conduction the experiments.

Mechanical analysis		Chemical analysis	
Coarse sand %	67.98	pH (1:2.5 suspension)	7.80
Fine sand %	24.56	E.C (m mohs/cm 1:5)	0.136
Silt %	3.13	Organic matter %	0.470
Clay %	4.33	Available N (ppm)	18.212
Soil texture	Sandy	Available P (ppm)	2.192
		Available K (ppm)	73.980

Split plot design with three replications were used. Seeding rates were allocated at random in the main plots, while biofertilizers with nitrogen rates were randomly distribution in the sub plots as follows :

1- Inoculation with *Azotobacter chroococcum*.
2- Inoculation with *Azospirillum* spp.
3- Inoculation with *Azotobacter* and *Azospirillum*.
4- Inoculation with *Azotobacter* + 1/2 N (60 kg N/fed).
5- Inoculation with *Azotobacter* + 3/4 N (90 kg N/fed).
6- Inoculation with *Azospirillum* + 1/2 N (60 kg N/fed).
7- Inoculation with *Azospirillum* + 3/4 N (90 kg N/fed).
8- Inoculation with *Azotobacter* and *Azospirillum* + 1/2 N (60 kg N/fed).
9- Inoculation with *Azotobacter* and *Azospirillum* + 3/4 N (90 kg N/fed).
10- Full nitrogen (recommended 120 kg N/fed).

The inoculation was performed by coating wheat grains with each inoculum individually at rate of 400 g inoculant/75 kg grains, but in case of mixed inoculum, 200g from each inoculant were mixed and added to wheat grains. Sticking substance (Arabic gum 5%) was used to stick the inoculant materials with grains just before sowing.

Wheat plants (cv. Giza 168) were sown at 18th and 25th November 2002/2003 and 2003/2004, respectively. Plot size was (3 x 3.5 m), which contained 15 rows, 3 m in length and 20 cm apart. Nitrogen fertilizer as a form of ammonium sulphate 20.5% N was applied in six equal doses until 7 days before flowering stage. Phosphorus fertilizer was added at rate of 31 kg P_2O_5 (as calcium superphosphate 15.5%) at soil preparation and 24 kg K_2O (as a form of potassium sulphate 48%) was applied in two equal doses, the first dose was applied during preparing the soil, but the second dose was applied after one month from sowing. Sprinkler irrigation for 4 hours every 4 days was conducted. The plants were harvested on 27th and 30th April in 2002/2003 and 2003/2004, respectively. At harvest time, ten guarded plants were taken at random from the middle of each plot to estimate data of yield components. The yield of grain and straw were calculated from the yield of whole plot. The following data were recorded: plant height, number of tillers/plant, number of spikes/m^2, spike length, number of grains/spike, 1000-grain weight, grain yield (ardab/fed) and straw yield (ton/fed).

Samples of grains were taken and dried, then grounded to powder for determining nitrogen by using Micro-Kjeldahl method of A.O.A.C. (1990). Crude protein percentage was calculated by multiplying the total nitrogen values by 5.7, then protein yield kg/fed was calculated. The data were

statistically analyzed according to the procedures outlined by Snedecor and Cochran (1981). The combined analysis of the two growing seasons (Table, 2) were done as the result followed similar trend and L.S.D was used to compare the treatments means.

RESULTS AND DISCUSSION

I. Effect of seeding rates :

The data in Table (3) indicated that all characters under study were significantly affected by seeding rates. Increasing seeding rates from 60 to 80 kg/fed decreased significantly number of tillers/plant, spike length, number of grains/spike, 1000-grain weight, grain yield/fed and protein yield/fed. On contrary, increasing seeding rates from 60 to 80 kg/fed increased significantly plant height, number of spikes/m^2, straw yield/fed and protein percentage. The increase in plant height in dense sowing may be attributed to the reduction in light intensity within plant canopy, which IAA synthesis and hence, increased cell elongation. The increase in number of spikes/m2 is mainly due to the increase of plant number per unit area. Also, increasing seeding rates from 60 to 80 kg/fed decreased size of grain and therefore less quantity of carbohydrates, hence increasing protein percentage. These results are in accordance with that obtained by Hegazi *et al.* (1982), Yakout *et al.* (1998), Hamada *et al.* (2001), Abd-Alla (2002), El-Nady (2003), Saleh (2003) and El-Wakil and Abd-Alla (2004) in the same trend in most of characters studied, but different from in others. Hegazi *et al.* (1982) found that no significant differences were obtained for the yield and 1000-kernel weight up to 100 kg seeds/fed. Yakout *et al.* (1998) indicated that plant height and grain yield/fed. were significantly increased by increasing seeding rates up to 60 and 80 kg/fed, respectively, while protein percentage was significantly decreased by increasing seeding rates. Hamada *et al.* (2001) showed that the tallest plants were obtained up to 60 kg seeds/fed. However, Abd-Alla (2002), El-Nady (2003), Saleh (2003) and El-Wakil & Abd-Alla (2004) reported that increasing seeding rates were increased significantly grain yield. As well as El-Nady (2003) and Saleh (2003) concluded that plant height did not affect significantly by seeding rates, but El-Wakil and Abd-Alla (2004) found that plant height was significantly increased by increasing seeding rates. El-Nady (2003) indicated that number of tillers/plant and number of grains/spike did not affect by seeding rates. And, also Saleh (2003) found that 1000-grain weight did not affect significantly by increasing seeding rates. But, El-Wakil and Abd-Alla (2004) showed that number of grains/spike and spike length were significantly increased by increasing seeding rates, on the other hand, straw yield/fed was not affected by seeding rates.

II. Effect of fertilization (biofertilizers and mineral nitrogen) :

Data presented in Table (3) showed the effect of some biofertilizers in combination with mineral nitrogen on yield and its components of the wheat variety Giza 168. Different treatments of biofertilizers and mineral nitrogen had significant effect on yield, its components, protein percentage and total yield of protein.

Table (2): ANOVA combined of the studied characters over the two seasons 2002/2003 and 2003/2004.

S.O.V	d.f.	Plant height (cm)	No. of tillers/ plant	No. of spikes/ m^2	Spike length (cm)	No. of grains/ spike	1000-grain weight (g)	Grain yield (ard/fed)	Straw yield (ton/fed)	Protein (%)	Protein yield (kg/fed)
Years (Y)	1	28.519	0.024	1136.336	3.799	41.313	33.117	2.174	4.317	0.954	2414.454
Error 1	4	3.587	0.077	56.043	0.227	0.147	1.240	0.601	0.016	0.044	68.092
Seeding rate (A)	1	465.314**	2.352**	2407.642**	6.161**	110 842**	62.814**	12.773**	2.252**	2.581**	1543.056**
Y x A	1	0.520	0.015	1370.454	0.757	5.229	0.208	0.521	0.961	0.411	3.928
Error 2	4	13.389	0.013	36.126	0.258	0.795	0.624	0.116	0.027	0.018	27.356
Fertilizer (B)	9	4213.019**	8.266**	85978.465**	77.124**	1379.954**	519.753**	272.533**	18.170**	9.555**	85991.542**
Y x B	9	1.249	0.070	251.220	0.386	0.398	0.829	0.277	0.659	0.057	65.491
A x B	9	9.085**	0.111**	175.843**	0.161	2.182	1.066*	0.827**	0.193**	0.104**	67.609**
Y x A x B	9	1.253	0.028	188.973	0.349	1.366	0.463	0.255	0.516	0.032	20.035
Error 3	72	4.220	0.022	59.080	0.117	1.084	0.411	0.252	0.043	0.033	17.629
Total	119										

Table (3): Effect of seeding rates and fertilization (Bio + N) on growth, yield, yield components and protein content in grains of wheat (averages of combined analysis for two seasons 2002/2003 and 2003/2004).

Characters / Treatments	Plant height (cm)	No. of tillers/ plant	No. of spikes/ m^2	Spike length (cm)	No. of grains/ spike	1000-grain weight (g)	Grain yield (ard/fed)	Straw yield (ton/fed)	Protein (%)	Protein yield (kg/fed)
Seeding rates :										
60 kg/fed.	78.54	2.30	208.12	8.68	35.01	37.72	10.32	2.57	10.25	164.29
80 kg/fed.	82.47	2.02	217.07	8.22	33.09	36.27	9.66	2.84	10.55	157.12
L.S.D at 5%	1.86	0.06	3.05	0.26	0.45	0.40	0.17	0.08	0.07	2.65
1%	3.08	0.10	5.05	0.43	0.75	0.66	0.29	0.14	0.11	4.40
Fertilization :										
A	53.82	1.01	90.36	4.98	16.53	27.47	3.40	1.00	9.11	46.33
B	52.35	1.03	88.33	4.65	17.93	27.29	3.35	1.00	9.17	45.59
A + B	57.13	1.11	103.03	5.42	20.10	28.80	3.67	1.08	9.34	51.05
A + 1/2 N	84.73	2.13	231.55	8.48	37.42	38.12	10.57	2.84	10.51	165.39
A + 3/4 N	95.76	2.88	279.47	10.68	42.42	42.87	14.42	4.02	11.20	242.11
B + 1/2 N	84.22	2.10	232.58	8.24	36.92	38.00	10.41	2.84	10.37	161.60
B + 3/4 N	94.93	2.83	279.20	10.50	41.74	42.29	14.32	4.00	11.09	239.46
A + B + 1/2 N	86.48	2.53	249.13	9.26	39.41	39.98	11.28	3.03	10.59	172.22
A + B + 3/4 N	98.37	3.05	297.87	11.46	43.99	43.56	14.44	3.55	11.39	246.45
N	97.28	2.92	274.43	10.62	42.02	41.56	14.06	3.67	11.24	236.87
L.S.D at 5%	1.67	0.12	6.26	0.28	0.85	0.52	0.41	0.17	0.15	3.42
1%	2.22	0.16	8.30	0.37	1.12	0.60	0.54	0.22	0.20	4.53

Results indicated that inoculation with *Azotobacter* + *Azospirillum* and 3/4 nitrogen (90 kg N/fed) gave the highest values of all studied characters (except straw yield) followed by the treatment (inoculation with *Azotobacter* + 90 kg N/fed) in all studied characters (except, plant height, number of tillers/plant and protein percentage) where followed by 120 kg N/fed. However, the values of the most characters which inoculation by *Azotobacter* were higher than inoculation by *Azospirillum* except, number of tillers/plant and protein percentage, while inoculation by *Azotobacter* or *Azospirillum* on the straw yield/fed gave the same trend. These results are in agreement with Koreish *et al.* (1998) they reported that the total yield generally tended to insignificant increase by *Azotobacter* inoculate than by *Azospirillum*, *Azotobacter* was relatively more efficient than *Azospirillum*. The result in (Table 3) indicated that no significant differences could be observed between inoculation by biofertilizers + 90 kg N/fed and application of 120 kg N/fed on all characters under study. The results indicated that inoculation by biofertilizers could save 25% of the recommended nitrogen especially in new lands and decrease environmental pollution.

These results confirms the view that using biofertilizers play an important part not only from the economical part of point of view but also in improving grains quality by increasing protein %, in addition reducing environmental pollution, resulting of using chemical fertilizers. Hussien *et al.* (1993) found similar results. Meanwhile, it is to be mentioned that the negative effect of some biofertilizers on grain yield could be ascribed to increasing fixed N_2 in the rhizosphere that led to more vegetative growth at the expense of grain yield, Bedaiwi *et al.* (1997) and El-Baggory *et al.* (2001). Generally, it can be concluded that biofertilizers x N or N was more effective than other treatments to improve productivity and reduce mineral N requirements as well.

These results were in agreement with those found by Abdel Aziz *et al.* (1989), Patra *et al.* (1989), Omar *et al.* (1991), Hussein *et al.* (1993), Saber (1993), El-Baggory *et al.* (1996), Mitkees *et al.* (1996), Bedaiwi *et al.* (1997), Sharaan and Abd El-Sami (1999), El-Baggory *et al.* (2001), Saleh (2003) and El-Wakil *et al.* (2004).

III. Effect of the interaction between seeding rates and fertilization :

With respect to the interaction between seeding rates and inoculation by *Azotobacter* or *Azospirillum* or mixture of them with mineral nitrogen were recorded in Table (4). Data indicated that plant height, number of tillers/plant, number of spikes/m^2, 1000-grain weight, grain, straw and protein yields/fed and protein % of wheat plants were significantly affected by the interaction between seeding rates and fertilizetion by biofertilizers with mineral nitrogen. The highest averages of number of tillers/plant, 1000-grain weight, grain and protein yields/fed were obtained from 60 kg seeds/fed and mixture of biofertilizers (*Azotobacter* + *Azospirillum*) with 3/4 N (90 kg N/fed), whereas, the highest values of plant height, number of spikes/m^2 and protein % were obtained from 80 kg seeds/fed and mixture of biofertilizers with 3/4 mineral nitrogen (90 kg N/fed). On the other hand, the highest straw yield was obtained from 80 kg seeds/fed and 120 kg N/fed.

Table (4): Effect of the interaction between seeding rates and fertilization (Bio + N) on wheat characters (averages of combined analysis during 2002/2003 and 2003/2004 seasons).

Treatments		Characters							
Seeding rate	Fertilization	Plant height (cm)	No. Of tillers/ plant	No. of spikes/ m^2	1000-grain weight (g)	Grain yield (ard/fed)	Straw yield (ton/fed)	Protein (%)	Protein yield (kg/fed)
60 kg/fed.	A	53.07	1.03	87.20	27.83	3.53	0.91	9.05	47.74
	B	51.67	1.06	85.15	27.57	3.49	0.90	9.20	47.29
	A + B	55.73	1.14	98.78	29.49	3.73	0.94	9.23	51.48
	A + 1/2 N	82.48	2.30	231.96	38.96	10.91	2.56	10.26	168.44
	A + 3/4 N	94.05	3.12	271.31	43.92	15.05	3.77	11.01	248.62
	B + 1/2 N	81.95	2.30	234.88	38.87	10.72	2.65	10.24	164.26
	B + 3/4 N	92.98	3.02	269.76	43.42	14.83	3.51	10.79	243.60
	A + B + 1/2 N	83.97	2.58	240.52	40.84	11.19	2.99	10.43	174.70
	A + B + 3/4 N	94.90	3.28	293.45	44.39	15.11	3.48	11.24	253.99
	N	94.55	3.17	268.14	41.90	14.62	3.64	11.07	242.81
80 kg/fed.	A	54.57	1.00	93.52	27.11	3.27	1.10	9.17	44.93
	B	53.03	1.00	91.51	27.01	3.21	1.10	9.13	43.89
	A + B	58.52	1.08	107.28	28.12	3.60	1.21	9.44	50.63
	A + 1/2 N	86.98	1.95	231.13	37.29	10.22	3.12	10.76	162.34
	A + 3/4 N	97.47	2.65	287.63	41.83	13.78	4.26	11.39	235.60
	B + 1/2 N	86.48	1.90	230.28	37.13	10.11	3.03	10.50	158.94
	B + 3/4 N	96.87	2.65	288.64	41.17	13.81	4.32	11.38	235.32
	A + B + 1/2 N	88.98	2.48	257.74	39.12	11.37	3.10	10.75	169.74
	A + B + 3/4 N	101.83	2.83	302.28	42.73	13.77	4.47	11.53	238.90
	N	100.00	2.68	280.72	41.21	13.50	4.51	11.41	230.93
L.S.D. at 5%		2.37	0.17	8.85	0.74	0.58	0.24	0.21	4.83
1%		-	0.23	11.74	-	0.77	0.32	0.28	6.41

The data in Table (4) revealed that the highest grain yield/fed (15.11 ardab/fed) was obtained from 60 kg seeds/fed and mixture of biofertilizers with 3/4 N (90 kg N/fed). This increase was 2.7% in grain yield/fed over fertilization by 120 kg N/fed only.

Taking in our consideration, the main components of wheat crops including grain, straw and protein yield, those parameters were positively affected by both inoculation and N-fertilization. Data presented in Table (4) clearly indicates that the level of N-fertilizer applied was of a great importance especially when wheat inoculated with mixed culture of *Azotobacter* and *Azospirillum*. These could be observed from cheking ulfe ence between inoculated treatments that received N-fertilizer and other treatments. This positive effect was true at the two levels of seeding rates. At 30 kg seed/fed the relative increase in the total protein yield was on the average 339.3 and 393.4% for wheat plants received 60 and 90 kg N/fed, respectively compared with inoculation treatment only. On contrary, the higher level of N-fertilizer (120 kg N/fed) showed slight decrease in nitrogen yield, (Table 4) as compared with dual inoculation + 90 kg N/fed, achieving N-recovery about 25.0%. Several positive effects were reported by Knowles (1974), Roger and Watanabe (1986), Wani (1986), Baldani *et al.* (1987) and Da Silva *et al.* (1993). It is worthy to mention that by increasing the level of N-fertilization from 60 to 90 kg N/fed along with inoculation with mixed culture, the grain, straw and protein yield are increased by 2.8, 30.5 and 43.1%. Such study need to evaluated the economic values to compare between cost and gross return when excess of N was applied.

From the previous results, it can be concluded that the application of biofertilizers on wheat plants is important for sustainable agriculture, by reducing the cost of using N fertilizers about 25%, especially in new lands and by reducing environmental pollution. El-Baggory *et al.* (2001) came nearly to same conclusion.

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دراسة كفاءة معدلات التقاوى وبعض المخصبات الحيوية مع النيتروجين المعدنى على النمو والمحصول ومكوناته ومحتوى البروتين لمحصول القمح فى الأراضى الرملية

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بالإسماعيلية - مركز البحوث الزراعية موسمى ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤ لدراسة تأثير معدلين من التقاوى (٦٠ ، ٨٠ كجم/ف) ، والمعاملة بنوعين من المخصبات الحيوية (أزوتوباكتر ، أزوسبيريللم) مع النيتروجين المعدنى وكانت كالآتى :-

١- أزوتوباكتر ٢- أزوسبيريللم ٣- أزوتوباكتر + أزوسبيريللم

٤- أزوتوباكتر + ٦٠ كجم ن/ف (٢/١ الموصى به للأراضى الرملية).

٥- أزوتوباكتر + ٩٠ كجم ن/ف (٤/٣ الموصى به للأراضى الرملية).

٦-أزوسبيريللم + ٦٠ كجم ن/ف . ٧- أزوسبيريللم + ٩٠ كجم ن/ف .

٨- أزوتوباكتر + أزوسبيريللم + ٦٠ كجم ن/ف. ٩- أزوتوباكتر + أزوسبيريللم + ٩٠ كجم ن/ف.

١٠- ١٢٠ كجم ن/ف فقط (الموصى به للأراضى الرملية).

وذلك مع صنف القمح جيزة ١٦٨ فى الأراضى الرملية تحت ظروف الرى بالرش. وكان التصميم المستخدم قطع منشقة مرة واحدة فى ثلاث مكررات وكانت النتائج المتحصل عليها كالتالى :-

١- أعطى معدل التقاوى ٦٠ كجم/ف زيادة معنوية فى الصفات عدد الأفرع /نبات ، طول السنبلة ، عدد الحبوب/سنبلة ، ووزن الألف حبة ، محصول الحبوب والبروتين للفدان. بينما أعطى المعدل ٨٠ كجم/ف زيادة معنوية لطول النبات ، عدد السنابل/نبات ، محصول القش والنسبة المئوية لبروتين الحبوب.

٢- واظهرت النتائج أيضا أن المخصب الحيوى الأزوتوباكتر اعطى قيما أعلى من الأزوسبيريللم لجميع الصفات تحت الدراسة ولكنها لم تصل الى حد المعنوية وزاد محصول الفدان بحوالى ٢,٧% عند المعاملة بالأزوتوباكتر او الأزوسبيريللم أو خليط منهما.

٣- وأثر التفاعل معنويا على جميع الصفات تحت الدراسة وأعلى قيمة من محصول الحبوب للفدان تم الحصول عليها من ٦٠ كجم تقاوى والتسميد الحيوى بالأزوتوباكتر والأزوسبيريللم مع ٩٠ كجم ن/ف (٤/٣ الموصى به من النيتروجين للأراضى الرملية).