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INFLUENCE OF BIO AND CHEMICAL FERTILIZERS ON GROWTH, YIELD AND QUALITY OF WHEAT

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ABSTRACT

Two field experiments were conducted at El-Hamoul area, Kafr El-Sheikh Governorate, Egypt during 2010/2011 and 2011/2012 seasons, to study the effect of six biofertilization treatments (Without biofertilization (control),inoculation wheat seeds with Nitrobine (450 g/feddan) 100% of the recommended dose , Nitrobine (675 g/feddan) 150% from the recommended dose, Cerialine (450 g/feddan) recommended dose and Cerialine (675 g/feddan) 150% from recommended dose) and four nitrogen rates (0, 30, 50 and 70kg N/feddan.) and their interactions on growth, yield and quality of wheat .

-The obtained results indicated that plants produced from seeds inoculated with nitrobine at the rate of 150% from the recommended dose gave the highest number of spikes/m^2, 1000 grains weight, grain yield/feddan, straw yield/feddan., carbohydrate % and protein% in grains in both seasons.

- Application of nitrogen fertilizer at the rate of 70 kg N/feddan surpassed all the other treatments in all measured parameters in both seasons.

- The interaction effect between biofertilizers and chemical nitrogen fertilizer rates was significant on all studied characters in both seasons. Wheat plants produced from grains inoculated by nitrobine at the rate of 150% and received nitrogen fertilizer at that rate of 70 kg N/feddan gave the highest values of studied traits in both seasons. Treatment having nitrobine at the rate of 150%

INTRODUCTION

Wheat (*Triticum aestivum L .*) is considered the main source of food in the world and Egypt . Increasing the productivity of wheat is the most important national target to minimize the gap between the Egyptian production and wheat consumption .Such increase is likely to be obtained by increasing productivity per unit area . Improvement of wheat production per unit area can be achieved through optimizing the agricultural practices such as fertilization i.e. good management program concerning nitrogen fertilizer sources and rate.

Nitrogen is a major nutrient element and it's needed in large amount for high yield of wheat and it considered the most factor affecting the growth and productivity of wheat. Sharief *et al*., (1998) indicated that yield and yield attributes of wheat significantly respond to nitrogen application up to 75 kg N/ha. Increasing nitrogen levels significantly increased plant height, number of spikes/$m^{2,}$ spike length, number of grains/spike, 1000 kernels weight, straw and grain yield and harvest index (Sharsher *et al*., 2000; Sushila andGajendra, 2000 and Salelh, 2002).

Recently, pollution has drawn a lot of attention at local and international levels. One of the important sources of pollution is the use of various

One feddan = 0.42 hectare

chemicals in agriculture. Increasing amounts of mineral fertilizer constitutes is considered a major reason of soil pollution. So, minimizing the use of these chemicals is a way to reduce pollution. One way to reduce the application of mineral nitrogen fertilizer is the use of biofertilization. Omar *el al*., (1991) reported that inoculation of seed wheat with bio-fertilizer bacteria could save around 37.5-41.6% of nitrogen fertilizer. Emara ,(1994), Ahmed, (1995), El-Metwally, (1998), Sushila and Gajendra ,(2000) and El-Kalla *et al*., (2002) demonstrated that bio-fertilizers significantly boosted up all yield attributes and yield of wheat crop.

The objectives of this study aims to investigate the effect of bio-fertilizer and mineral nitrogen fertilizer rates on growth, yield and quality of wheat at El-Hamoul area, Kafr El-Sheikh Governorate conditions, Egypt.

MATERIALS AND METHODS

The present investigation was conducted at El-Hamoul area, Kafr El-Sheikh Governorate, Egypt during 2010/2011 and 2011/2012 winter seasons, to study the effect of biofertilization, mineral nitrogen fertilizer rates and their interactions on growth, yield and quality of wheat, cv.Sakha 93 . The experiment treatments studied were as follows:

I- Biofertilization treatments:

1- Without biofertilization (control).
2- Inoculation wheat seeds with Nitrobine (450 g/feddan) recommended dose.
3-Inoculation wheat seeds with Nitrobine (675 g/feddan) 150% from recommended dose.
4- Inoculation wheat seeds with Cerialine (450 g/feddan) the recommended dose.
5- Inoculation wheat seeds with Cerialine (675 g/feddan) 150% from recommended dose.
6- Inoculation wheat seeds with Netrobine (225 g/feddan) 50% recommended dose+ Cerialine (225 g/fed) 50% recommended dose.

II- Nitrogen rates:

- 0 kg N/fed.
- 30 kg N/fed.
- 50 kg N/fed.
- 70 kg N/fed.

Cerialine *(Azospirillum brzsilense and Bacillus polymyxa*) and Nitrobine (*Azotobacter spp and Azospirillum spp*) as commercial products were produced by Biofertilizer Unit, Agricultural Research Center (ARC), Giza, Egypt, which included free-living bacteria able to fix atmospheric nitrogen in the rhizosphere of soil. Nitrogen fertilizer in the form of urea (46% N) was applied as a side-dressing in two equal doses, one half after 30 days after sowing and the other at 70 days after sowing.

The experiments were laid out in split plot design in three replications. The bio fertilizers treatments were randomly distributed in the main plots,

while nitrogen rates were allocated at random in the sub plots. The area of sub plot was 10.5m2 (3.0m width x 3.5m length).

Soil samples were randomly taken from the experimental sites at depth of 0 to 30 cm from soil surface for determining the physical and chemical properties in 2010/2011 and 2011/2012 seasons according to Chapman and Pratt (1961) and the values are shown in Table 1.

Table (1): Chemical and Mechanical analysis of the experimental sites in 2010/2011 and 2011/2012seasons.

characters	seasons	
	2011	2012
A- Chemical characters:		
PH	7.11	7.33
E.C.	1.36	1.48
Total N%	0.40	0.44
Available P (ppm)	18.00	17.85
Available Zn (ppm)	5.22	5.34
Available K (ppm)	1.35	1.26
Total soluble salts	9.96	10.26
B- Mechanical characters:		
Soil texture	Clay	Clay
Sand %	12.76	12.69
Silt %	21.81	20.56
Clay %	66.44	64.66

Potassium fertilizer was added in the form of potassium sulphate (48% K_2O) at the rate of 100kg /fed. Phosphorus fertilizer as superphosphate (15.5% P_2O_5) was also added at the rate of 100kg / fed before planting for all plots. Seeds were hand sown on 15and 16 November in 2010/2011 and 2011/2012 seasons, respectively. Other cultural practices were done as recommended for wheat crop usually followed in the region.

Data recorded:

The collected data in the experiment involved the following traits:

- Number of spikes /$m^{2.}$
- 1000 grain weight (g).
- Grain yield (ardab / feddan).
- Straw yield / feddan (ton).
- Carbohydrate percentage in grains. It was measured according to Dubious and Gilles (1956).
- Protein percentage in grains. It was measured according to the improved Keldahel method of A.O.A.C. (1980).

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-plot design by using “MSTAT-C" Computer software package and least significant difference (LSD) method was used to test the differences between treatment means at 5 % levels of probability according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Average number of spikes/m^2, 1000 grains weight, grain yield/feddan, straw yield/feddan, carbohydrate percentage in grains and protein percentage in grains were affected by biofertilizers and nitrogen fertilizer rates as well as their interactions during 2010/2011 and 2011/2012 seasons as shown in Tables 2 – 4.

Table 2: Average number of spikes/m^2 and 1000 grain weight (g) of wheat as affected by biofertilizers and chemical nitrogen fertilizer rates and their interactions in 2010/2011 and 2011/2012 seasons.

Biofertilizers treatments (B)	Number of spikes/m^2					1000 grain weight (g)				
	2010/2011 season					2010/2011 season				
	Chemical N – rates (N)				Mean	Chemical N – rates (N)				Mean
	0	30	50	70		0	30	50	70	
control	136.00	335.00	418.00	461.00	337.50	22.83	49.20	51.73	52.53	44.07
Nitrobein 100%	168.66	362.33	434.66	487.66	363.33	23.60	51.20	53.40	54.33	45.63
Nitrobein 150%	177.33	387.66	484.00	499.66	387.16	23.90	51.83	53.80	55.46	46.25
Cerialein 100%	155.66	347.00	384.00	428.33	328.75	22.80	50.43	51.53	52.43	44.30
Cerialein 150%	168.66	351.66	431.00	448.66	350.00	23.03	50.74	52.16	53.66	44.90
Nitrobein 50% +Cerialein 50%	175.00	340.66	411.66	455.33	345.66	23.53	51.16	52.30	52.70	44.92
Mean	163.55	354.05	427.22	463.44	352.06	23.28	50.76	52.48	53.52	45.01
L.S.D. at 5% for B	4.53					0.34				
N	3.86					0.19				
BxN	9.45					0.48				
Biofertilizers treatments (B)	2011/2012 season					2011/2012 season				
	Chemical N – rates (N)				Mean	Chemical N – rates (N)				Mean
	0	30	50	70		0	30	50	70	
control	153.66	347.66	423.66	467.33	348.08	22.96	49.43	51.90	52.90	44.30
Nitrobein 100%	172.33	368.33	453.00	462.33	314.00	23.83	51.40	53.61	54.60	45.86
Nitrobein 150%	179.00	397.33	489.00	504.00	392.33	24.25	52.43	54.00	55.73	46.60
Cerialein 100%	161.66	352.00	385.33	435.33	333.58	22.93	50.91	51.75	52.63	44.55
Cerialein 150%	169.00	358.66	435.33	462.00	356.25	23.25	51.20	52.63	53.90	45.24
Nitrobein 50% +Cerialein 50%	178.00	345.66	415.00	456.00	348.66	23.96	51.56	52.63	53.21	45.34
Mean	168.94	361.61	433.55	464.50	457.15	23.53	51.15	52.75	53.83	45.32
L.S.D. at 5% for B	12.19					0.44				
N	9.47					0.22				
BxN	23.20					0.54				

*** 100 %, 150 % and 50 % of the recommended dose.**

The results presented in Tables 2 – 4 indicated that the effect of biofertilizers was significant on all studied traits in both seasons. Wheat plants treated with biofertilizers had a significant increase in all studied traits compared to untreated plants (control) in both seasons .The highest number of spikes/m^2(387.16 and 392.33), 1000 grain weight (46.25 and 46.60g) , grain yield/feddan (16.43 and 16.83 ardab), straw yield/feddan (2.85 and 2.98 tons), carbohydrate percentage in grains(67.04 and 67.29%) and protein percentage in grains (12.10 and 12.13%) were obtained by application nitrobine at the rate of (150% gm from recommended dose) . On

the other hand, untreated plants with biofertilization (control) gave the lowest values of number of spikes/m^2 (337.50 and 348.08), 1000 grains weight (44.07 and 44.30 g), grain yield/feddan (15.48 and 15.70ardab), straw yield/feddan (2.42 and 2.54 tons), carbohydrate percentage in grains (65.46 and 65.63%) and protein percentage in grains (11.54 and 11.60%) compared to other treatments in 2010/2011 and 2011/2012 seasons, respectively.

Table 3: Average grain yield/feddan (ardab) and straw yield/feddan (tons) of wheat as affected by biofertilizers and chemical nitrogen fertilizer rates and their interactions in 2010/2011 and 2011/2012 seasons.

Biofertilizers treatments (B)	Grain yield/feddan (ardab)					Straw yield/feddan (tons)				
	2010/2011 season					2010/2011 season				
	Chemical N – rates (N)				Mean	Chemical N – rates (N)				Mean
	0	30	50	70		0	30	50	70	
control	11.31	15.73	16.97	17.93	15.48	1.11	2.53	2.88	3.16	2.42
Nitrobein 100%	11.71	16.20	17.45	18.28	15.91	1.25	2.70	3.15	3.45	2.63
Nitrobein 150%	11.80	16.64	18.51	18.78	16.43	1.53	2.90	3.35	3.63	2.85
Cerialein 100%	11.33	15.91	17.21	18.06	15.63	1.19	2.41	2.75	3.10	2.36
Cerialein 150%	11.75	16.38	17.32	18.08	15.88	1.35	2.57	3.10	3.38	2.60
Nitrobein 50% +Cerialein 50%	11.71	16.08	16.99	17.90	15.67	1.22	2.66	3.02	3.28	2.54
Mean	11.60	16.16	17.40	18.17	15.83	1.27	2.63	3.04	3.33	2.57
L.S.D. at 5% for B	0.13					0.03				
N	0.12					0.03				
BxN	0.29					0.06				
Biofertilizers treatments (B)	2011/2012 season					2011/2012 season				
	Chemical N – rates (N)				Mean	Chemical N – rates (N)				Mean
	0	30	50	70		0	30	50	70	
control	11.42	15.90	17.19	18.30	15.70	1.20	2.63	3.00	3.33	2.54
Nitrobein 100%	11.52	16.33	17.53	18.61	16.00	1.26	2.86	3.31	3.57	2.75
Nitrobein 150%	11.91	16.95	19.06	19.40	16.83	1.63	2.98	3.51	3.78	2.98
Cerialein 100%	11.50	16.06	17.15	18.31	15.75	1.31	2.52	2.78	3.22	2.46
Cerialein 150%	11.98	16.60	17.57	18.35	16.12	1.51	2.66	3.23	3.58	2.74
Nitrobein 50% +Cerialein 50%	11.86	16.26	17.20	18.12	15.86	1.35	2.78	3.10	3.43	2.66
Mean	11.70	16.35	17.61	18.51	16.04	1.38	2.74	3.15	3.48	2.69
L.S.D. at 5% for B	0.12					0.06				
N	0.15					0.04				
BxN	0.38					0.11				

*** 100 %, 150 % and 50 % of the recommended dose.**

The increase in grain yield/feddan due to inoculation wheat seeds with nitrobine may be attributed to the raising number of spikes/m^2 and 1000 grains weight which led to increasing grain yield. These results are in harmony with those reported by El-Metwally, (1998), Sushila and Gajendra (2000) and El-Kalla *et al*. (2002) , who found that bio-fertilizers significantly boosted up all yield attributes and yield of wheat crop.

Results presented in Tables 2 – 4 show clearly that chemical nitrogen fertilizer rates significantly affected all studied traits in both seasons. Increasing of nitrogen from rate of 0 to 70 kg N/feddan increased number of spikes/m^2 by 283.365 and 274.95%, 1000 grains weight by 229.90 and

228.77%, grain yield/feddan by 156.64 and 158.21%, straw yield/feddan by 262.20 and 252.17%, carbohydrate percentage in grain by 106.71 and 106.80 % and protein percentage in grain by 119.94 and 119.71% in 2010/2011 and 2011/2012 seasons, respectively.

The increase in grain yield with increasing nitrogen rates might be due to increasing yield components i.e., number of spikes and 1000 grain weight which led to increase grain yield. In this connection the increase of carbohydrate and protein percentages in grains might be attributed to the increase in dry matter production, hence increased carbohydrate and protein content in grains. These results are in agreement with those of Sharsher *et al*. (2000); Sushila andGajendra (2000) and Salelh (2002), who reported that increasing nitrogen levels significantly increased number of spikes/$m^{2,}$ and 1000 kernels weight, protein and carbohydrate percentage.

Table 4: Average carbohydrates percentage and protein percentage in grains of wheat as affected by biofertilizers and chemical nitrogen fertilizer rates and their interactions in 2010/2011 and 2011/2012 seasons.

Biofertilizers treatments (B)	Carbohydrates percentage					Protein percentage				
	2010/2011 season					2010/2011 season				
	Chemical N – rates (N)				Mean	Chemical N – rates (N)				Mean
	0	30	50	70		0	30	50	70	
control	63.33	65.35	66.08	66.89	65.46	10.32	11.76	11.94	12.14	11.54
Nitrobein 100%	64.11	66.27	67.23	68.67	66.57	10.44	11.80	12.26	12.79	11.82
Nitrobein 150%	64.32	66.69	67.81	69.37	67.04	10.53	12.16	12.43	13.26	12.10
Cerialein 100%	63.52	65.62	66.49	67.55	65.79	10.37	11.80	12.03	12.33	11.63
Cerialein 150%	63.64	66.04	66.95	67.79	66.10	10.43	11.87	12.01	12.21	11.63
Nitrobein 50% +Cerialein 50%	63.72	65.85	66.95	68.23	66.19	10.49	11.86	12.14	12.33	11.70
Mean	63.80	65.97	66.92	68.08	66.19	10.43	11.87	12.13	12.51	11.74
L.S.D. at 5% for B	0.25					0.17				
N	0.13					0.09				
BxN	0.32					0.22				
Biofertilizers treatments (B)	2011/2012 season					2011/2012 season				
	Chemical N – rates (N)				Mean	Chemical N – rates (N)				Mean
	0	30	50	70		0	30	50	70	
control	63.65	65.47	66.27	67.14	65.63	10.41	11.80	11.98	12.23	11.60
Nitrobein 100%	64.28	66.33	67.39	68.65	66.66	10.56	11.88	12.28	12.87	11.90
Nitrobein 150%	64.45	66.86	67.95	69.90	67.29	10.58	12.17	12.51	13.29	12.132
Cerialein 100%	63.70	65.74	66.62	67.69	65.94	10.41	11.83	12.10	12.39	11.68
Cerialein 150%	63.84	66.10	67.13	67.95	66.25	10.53	11.96	12.10	12.14	11.68
Nitrobein 50% +Cerialein 50%	63.74	65.96	67.07	68.43	66.30	10.52	11.97	12.27	12.51	11.82
Mean	63.94	66.08	67.07	68.29	66.34	10.50	11.93	12.21	12.57	11.80
L.S.D. at 5% for B	0.32					0.18				
N	0.21					0.12				
BxN	0.50					0.28				

*** 100 %, 150 % and 50 % of the recommended dose.**

The obtained results indicated that, the interaction effect between biofertilizers and chemical nitrogen fertilizer rates was significant on all studied characters in both seasons. Wheat plants produced from seeds

inoculated by nitrobine at the rate of 150% and received nitrogen fertilizer at that rate of 70 kg N/feddan gave the highest values of number of spikes/m2 499.66 and 504.00, 1000 grain weight 55.46 and 55.73 g, grain yield/feddan 18.78 and 19.40 ardab, straw yield/feddan 3.63 and 3.78 tons, carbohydrate percentage in grain 69.37 and 69.90% and protein percentage in grain 13.26 and 13.29% compared to all other interaction treatments in 2010/2011 and 2011/2012 seasons, respectively, with exception of treatment having nitrobine at the rate of 150% from recommended dose and 50 kg N/feddan whereas it had insignificant differences with treatment combined nitrobine at the rate of 150% from recommended dose and 70 kg N/feddan in number of spikes/m2 and grain yield per feddan in the both seasons. These results suggested that it could be reduced application of nitrogen fertilizer rate to 50kgN/fed as a chemical fertilizer and instated of reduction by using biofertilization to reducing pollution and production payments.

Therefore, it could be recommended that treated wheat grains by nitrobine as a biofertilizer at the rate of 150% from recommended dose and applied nitrogen fertilizer at a rate of 50 kg N/feddan improved grain yield of wheat variety Sakha 93 at Al-Hamoul, Kafr El-Sheikh Governorate conditions.

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تأثير السماد الحيوى والمعدني على نمو ومحصول وجودة القمح

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قسم المحاصيل – كلية الزراعة – جامعة الأزهر – القاهرة – مصر

أجريت تجربتان حقليتان بمركز الحامول محافظة كفرالشيخ – مصر خلال موسمي ٢٠١٠/٢٠١١ و ٢٠١١/٢٠١٢م لدراسة تأثير ستة مستويات من التسميد الحيوى (بدون- خلط تقاوي القمح مع ٤٥٠جم من النيتروبين وهو المعدل الموصى به - خلط تقاوي القمح مع ٦٧٥جم من النيتروبين وهو ١٥٠% من المعدل الموصى به - خلط تقاوي القمح مع ٤٥٠جم من السيريالين وهو المعدل الموصى به - خلط تقاوي القمح مع ٦٧٥جم من السيريالين وهو١٥٠ % من المعدل الموصى به و خلط تقاوي القمح مع ٥٠% من المعدل الموصى به من النيتروبين مع ٥٠% من المعدل الموصى به من السيريالين) وأربعة مستويات من التسميد الأزوتى (بدون – ٣٠ - ٥٠ - ٧٠ كجم ن/فدان).

أظهرت النتائج أن تقاوي بذور القمح بمعدل ١٥٠% من الموصى به من النيتروبين أعطت أعلى قيم لكلا من عدد السنابل / م٢ , محصول الحبوب / فدان , محصول التبن / فدان , النسبة المئوية للكربوهيدرات و النسبة المئوية للبروتين فى الحبوب فى كلا موسمي الدراسة. أدت إضافة النيتروجين بمعدل ٧٠ كجم / فدان إلى التفوق على باقي المعدلات فى كل الصفات المدروسة فى كلا موسمي الدراسة .كان تأثير التفاعل

بين التسميد الحيوى و التسميد المعدني معنويا على كل الصفات المدروسة فى كلا موسمي الدراسة , حيث أعطت البذور

المعاملة بالنيتروبين ١٥٠% من الموصى به والمسمدة

بمعدل ٧٠ كجم ن / فدان أعلى القيم لكل الصفات المدروسة فى كلا موسمي الدراسة. وعموما لم يكن هناك فرق معنوى بين معاملة حبوب القمح بـ ١٥٠% نيتروبين مع ٥٠كجم ن / فدان والمعاملة بـ١٥٠% نيتروبين مع ٧٠ كجم ن / فدان فى عدد السنابل / م٢ , محصول الحبوب / فدان فى كلا موسمي الدراسة .

لذلك توصى الدراسة بخلط تقاوي القمح قبل الزراعة مع ٦٧٥جم من النيتروبين / فدان مع إضافة ٥٠ كجم ن / فدان وذلك لتقليل تكاليف الإنتاج والمحافظة على البيئة من التلوث بالنيتروجين .

قام بتحكيم البحث

أ.د / محمود سليمان سلطان	**كلية الزراعة – جامعة المنصورة**
أ.د / عبد الحميد محمد حسنين	**كلية الزراعة - جامعة الازهر**