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EFFECT OF BIOFERTILIZATION ON PRODUCTION OF WHEAT (*Triticum astevium*) UNDER THE CONDITIONS OF IRRIGATION BY TREATED SEWAGE WATER

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ABSTRACT: Two field trials were carried out in 1999-2000 and 2000-2001 seasons on sandy soil at Kalubiah Governorate to study the effect of four soil pH levels pH (6-7) , pH (7-8), pH (8-9), pH (9-10) and four biofertilization treatments: control (without biofertilization), Cerealin, Biogen and Nitroben on growth and yield as well as concentration of heavy metals (Zn, Cd, Pb, Ni and Co (ppm) for wheat (varierty Sakha 69).

The obtained results indicated that soil pH levels and biofertilization have significant effect on most of wheat characters such as number of tillers, number of grains / spike, grain weight / plant, grain yield / plot in g, grain yield / feddan in ardab of wheat. Meanwhile, Increasing soil pH levels decreased concentration of heavy metals Zn, Cd, Pb, Ni and Co by different percentages (%) for wheat in the first and second seasons.

INTRODUCTION :

Egypt is currently under the yoke of what may be rightly termed as water abuse. Although the problem of water shortage is so universal that it may even lead to vicious wars and conflicts in the near future, in countries like Egypt, suffering from over population as well as the limitedness of water recourses, the problem may even be more demanding. In addition, nitrogen is an element vital for animal and plant growth, it constitutes 78 % of the earth's atmosphere. It is one of the major costs in crop production. Biological nitrogen fixation is the most important alternative for overcoming high costs of N fertilizer input into cropping systems without substantial loss in yield.

In this connection Liu *et al.*, (1996) investigated the effects of swine

lagoon effluent on sugar cane growth and quality. The results showed that accumulation of Cu and Zn in the long- term irrigated soils were observed and utilizing the useful plant nutrients. Concentrations of heavy metals were within the safety range. Olivar *et al.*, (1996) found that raising soil pH Ca form 4.0 to 5.0 by using lime decreased Cd concentration in the grains of wheat and barley. Sobhi (1996) mentioned that using sewage water for irrigation caused an increase in the availability of macro, microelements and heavy metals in sandy soil. This increase in availability of Pb with increasing the period of using sewage water for irrigation had not reach the toxic levels in the plant.

Paula *et al.*, (1997) indicated that added of liming increased stalk and grain yield for sweet sorghum. On the other hand reduced heavy metals concentration. Thawale *et al.*, (1999) reported that using wastewater irrigation did not affect the germination of jowar (sorghum), (wheat) and mong bean. Seed/grain and straw yields of these crops were generally increased by irrigation with wastewater compare with normal water. Walid (2000) revealed that irrigation with industrial wastes increased of heavy metals in soils.

Caceres *et al.*, (1996a) found that seeds of wheat inoculated with either *Azospirillum brasilense* increased grain yields. Caceres *et al.*, (1996b) indicated that inoculation seeds of wheat with different strains of *Azospirillum brasilense* increased yield by 13.4% in 1988-1989, 24.3% in 1990-1991, and 15.5% in 1991-1992. Kulhari *et al.*, (1996) reported that maize grain yield and total N uptake increased above 120kg N and were increased by inoculation and application of growth stimulants. Badawy *et al.*, (1997) mentioned that double inoculation of maize cultivars (seed treatment + soil spray) gave better growth and yield.

Fares (1997) added that the inoculation of wheat with associative N_2 fixer (*Azotobacter Chroococcum*) + (*Rhizobium leguminosarum*) gave the highest increase in straw and grain yield of wheat plant. Abd Allah *et al.*, (1998) found that the inoculation of maize with 8biofertilizer increased plant height, 100-kernel weight and grain yield. Aly *et al.*, (1999) pointed out that seed inoculation with *Azotobacter chroococcum* in wheat cv. Sakha 69 increasing of yield. Woodard and Bly (2000) indicated that inoculation of maize seed with *Azospirillum brasilense* and *Azorhizobium calinodans*) increases grain yield. Medhat (2001) reported that use of nitrogen fixing bacteria gave the highest yield 43.9. g over the control and plants. Results indicated that effluent water as a source of irrigation can

be used safely for crop production. Zakaria (2000) found that using treated sewage water increased yield of wheat plant and its uptake from different nutrients. i.e. macro, micro and heavy elements. Concentration of heavy metals were lower than the maximum permissible limits given by F.A.O in 1985. content of heavy metals in either grain or straw yield of wheat plants was below the toxic level for the human or plants.

Samira (2001) indicated that applying sewage sludge to soil and plants increased micronutrients and heavy metals. However, the concentrations of these elements did not reach toxic levels.

MATERIALS AND METHODS

Sewage was applied to the sandy soils of Al-Gabal Al-Asfar since 1923. The source of such sewage is that from great Cairo sewage treated effluent. The total amount of such treated sewage effluent is about 8 million m^3 / d. from Cairo and 3 million m^3/d. from Alexandria.

These amounts of sewage effluent are available to reclaim 40.000 hectares (Abdel A-di, 1992). Trace metals in the wastewater, however, present some problems for plants and humans. many trace elements are micronutrients essential for growth of plants and animals, yet most of them have no known essential physiological function. At high enough concentration all trace elements become toxic to some specific higher Plants ***(Ross and kaye, 1994 and Cameron et al.,, 1997)***. The purpose of this study is the production of yields containing minimal concentrations of heavy metals, or at least within the internationally recognized permissible limits.

Two field experiments were conducted at Al-Gabal -Al Asfar farm. Kalubiah Govemorate during 1999- 2000 and 2000 -2001 seasons on, Sakha 69 wheat variety Physical and chemical characteristics of the experimental soil before planting and after harvest are shown in Tables(1-3).

The area of the experiment was about eight kirates (672 m^2) every year divided into 64 plots. The area of each plot was 10.5 m^2 (3x3.5).

The experiment was designed in randomized complete block design 2 factor factorial with four replicates, which includes two factors. pH levels factor included four pH levels as follows: pH 6.3 (control), pH 7-8, pH 8-9 and pH 9-10 .pH levels were modified by adding lime to the depth of 20 cm from the soil surface area and the lime was homogeneously mixed

with the soil.. The rates of lime were as follows: zero, 1.5, 2.0 and 2.5 g lime / kg soil. These amounts were calculated as follows: laboratory experiment was carded out on samples of 100 g of the sandy soil by adding different amounts of lime to increase the pH from pH 6.3 (control) to pH 7-8, pH 8-9 and pH 9-10 which were 0.15 gin, 0.2 and 0.25 lime per 100 gm soil, respectively.

Area of plot x replicates of number x 20 cm x soil specific gravity. The lime added to each treatment was:

1- Treatment without lime (pH sandy soil for experiment).= zero

2-pH 7-8 = 3x3.5 x4 (replicates) x 238 (weight m3 soil) x 1.5(amount of lime /kg soil).

= 10.5 x 4 x 238 x 1.5 = 15 kg of lime /replicate

= 15 x 4 (replicates) = 60 kg of lime

3- pH 8-9 = 3x3.5 x 4 (plots) x 4 (replicates) x 238 x 2.0

= 42 x 4 x 238 x 2.0 = 80 kg of lime

4- pH 9-10 = 42 x 4 x 238 x 2.5 = 100 kg of lime

The second factor, biofertilization, treatments were as follows:

(1) Control (without applying biofertilization)

(2) Cerealin (The microorganism was Azospirillum brasilense with recommended rates)

(3) Biogen (the microorganisms. *Azotobacter chroococcum)*

(4) Nitroben (which contains two microorganisms. (*Azotobacter chroococcum+Azospirillum brasilense).*

The adding of. organic fertilization, superphosphate and Potassium sulphate was with recommended rates in the sandy soil ($20m^3$ organic matter. 150 kg / fed super phosphate (15.5 % P_2O_5) and 100 kg /fed (48% K_2O). Wheat was both planted on November 15. The amount of seeds used was 50 kg / fed, Wheat was irrigated once a week starting from November, and every four days starting from February. Harvesting time was on the 15^{th} April.

Soil Samples :

After the application of the lime and before planting, one sample was

taken to determine the chemical and physical characteristics as well as the heavy metals concentration in each single season. After the harvest, four samples were taken to determine the pH and one sample to determine the chemical and physical characteristics as well as the concentration of the heavy metals. The above samples were determined in the acid solution using Unicam Sp. 1900 atomic absorption spectrophotometer in a DTBA extract. The nitrogen samples were determined by the usual Kjeldahl method according to A.O.A.C (1995). Table (4) showed the chemical analysis of sewage water used in irrigation. On the other hand. Table (5) showed the limits of toxicity for the heavy metals under study in irrigated water, soil and plant as recorded by National Academy of Science (1972), Tictjen (1975) and Cottonie et al., (1976), All soil and sewage water analyses were carried out at the laboratories of Ministry of Agriculture's General Organization for Agr. Equalization Fund.

Grain samples :

Thirteen samples were taken from each season. One sample was taken from wheat grains of each treatment at harvest to determine the heavy metals as follows: Analysis was made on a known weight (0.5 g) of the dried samples and wet digestion was conducted using microwave oven (Milestone mps 1200 mega). The conditions for wet ashing were as follows: the sample was mixed with 6 ml of concentrated nitric acid (65% v/v) and heated with microwaves generated from the oven at moderate full power for 15 minutes. The applied procedure was according to Shaole *et al.*, (1997). Total content of zinc, lead, cadmium, nickel, cobalt were determined in the digested solution using inductively coupled plasma (400) emission spectrometry (Perkin Elmer Emission Spectrometer) according to Alien *et al.*, (1999).

Wheat Characteristics Studied

(1) Number of tillers.
(2) Number of grains per spike.
(3) Grain weight per plant in gm.
(4) Grain yield / plot in gm
(5) Grain yield / feddan in ardab.
(6) Concentration of heavy metals (Zn, Cd, Pb, Ni and Co) (ppm) in grain of wheat

Statistical analysis :

All data were subjected to statistical analysis of randomized complete block design 2-factor factorial according to procedures outlined by Snedecor and Cochran (1981). Treatment means were compared by least significant difference (L.S.D) at 5% level of probability.

Table (I): Particle size distribution, bulk density-and soil pH of the investigated soil of Al-Gabal AL-Asfar.

Soil Character	First season		Second season	
	Before planting	After harvest	Before planting	After harvest
% Sand coarse(2- 0.2mm)	62.63	68.5	63.6	64.95
% Sand fine (0.2 -0.02mm)	36.74	29.9	31.73	30.16
%Silt (0.02-0.002mm)	0.82	0.67	0.85	0.7
%Clay (< 0.002mm)	0.82	1.29	0.88	1.32
% Organic matter	0.43	0.64	0.45	0.85
% Filed capacity	8.51	16.65	8.29	16.51
Bulk density gm/cm3	1.58	1.32	1.59	1.42
E.C mohs/cm at 25 °C	0.72	0.75	0.73	0.77
pH(6-7)	6.61	6.1	6.33	6.2
pH(7-8)	7.9	7.1	7.8	7
pH(8-9)	8.7	8	8.9	8.3
pH(9-10)	9.5	9.1	9.6	9.2

Table (2): Some chemical characteristics of the investigated soil (Al-Gabal Al- Asfar)

Soil Characters	First season		Second season	
	Before planting	After harvest	Before planting	After harvest
CO_3 meq/1	-	-	-	-
HCO_3 meq/1	0.6	0.40	0.56	0.39
Cl meq/1	0.75	0.40	0.70	0.35
SO_4 meq/1	0.98	0.60	1.00	0.6.5
Ca meq/1	1.40	0.60	1.40	0.55
Mg meq/1	0.38	0.34	0.37	0.33
Na meq/1	0.55	0.30	0.50	0.35
K meq/1	0.05	0.06	0.04	0.05
Exchangeable cations capacity meq/ 100gm soil	5.11	4.77	5.08	4.47
N ppm	45	57	46	60
P ppm	28	37	31	41
K ppm	68	84	69	95

Table (3): Heavy metal concentration in the Al-Gabal Al- Asfar soil samples/ ppm

Heavy metals/ ppm	First season		Second season	
	Before planting	**After harvest**	**Before planting**	**After harvest**
Zn	8.00	14.00	7.00	13.00
Pb	0.75	1.25	0.88	1.30
Cd	0.05	0.07	0.05	0.09
Ni	0.50	0.84	0.51	0.86
Co	1.65	1.67	1.64	1.68

Table (4): Chemical analysis of sewage water samples.

Water Characteristics	First season		Second season	
	Before planting	After harvest	Before planting	After harvest
CO_3 meq/l	- -	-	-	-
HCO_3 meq/l	4.00	3.91	3.87	3.97
Cl meq/l	2.75	2.37	2.40	2.90
SO_4 meq/l	0.93	1.20	1.15	1.02
Ca meq/l	2.80	2.39	1.87	2.58
Mg meq/l	2.48	1.17	2.83	1.73
Na meq/l	2.15	2.27	2.40	2.65
K meq/l	0.48	0.88	0.39	0.45
Ec mohs/ Cm at 25 °C	0.79	0.86	0.77	0.78
PH	6.57	6.33	6.58	6.43
Znppm	1.35	1.38	1.48	1.40
Pb ppm	1.37	1.20	2.13	1.97
Cdppm	0.007	0.006	0.008	0.007
Ni ppm i	0.35	0.27	0.41	0.37
Co ppm	0.039	0.33	.0.032	0.028

Table (5) : Toxicity limits in water, soil and plant.

Element	Maximum conc.in irrigation water ppm*	Toxic conc.in soil ppm**	Toxic conc.in plant ppm***
Zn	2.0	400	>400
Pb	0.50	20-41	>60
Cd	0.01	2-9	>100
Ni	0.20	100	>80
Co	0.05	50	>100

* National Academy of Science (1972).

** Tictjen, C. (1975)

*** Cottenie *et al.*, 1976)

RESULTS AND DISCUSSION :

Concerning the effect of soil pH levels and biofetilization on Sakha 69 wheat variety characters, number of tillers, number of grains per spike, grain weight per plant in gm., grain yield / plot in gm., grain yield / feddan in ardab and concentration of heavy metals (Zn, Cd, Pb, Ni and Co) (ppm) in grains of wheat is shown in tables 6, 7, 8, 9, 10, 11, and 12 respectively.

Data in table (6) reveal that soil pH levels had significant effect positive on number of tillers per plant, number of grains per spike, grain weight per plant in g., grain yield / plot in g. and grain yield/ feddan in ardab, in both seasons. Wheat plants grown at pH level (8-9) gave the highest values in all the characters compared with the control (6-7). This can be explained by the fact that when soil pH decreases, heavy metals absorption increases. Consequently, concentration of heavy metals increases inside the cell until it reaches concentrations affecting the biological operations inside the cell, the matter that leads to decrease in

Table (6) : Effect of soil pH and biofertilization on number of tillers per plant of Sakha 69 wheat variety irrigated by sewage water in 1999 /2000 and 2000/2001 seasons.

1999/2000 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cereialin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	9.12	10.15	10.15	11.17	10.15
7-8 (1500 kg of lime/fed	10.07	11.57	11.37	12.52	11.38
8-9 (2000 kg of lime/fed	11.35	12.80	12.60	14.75	12.87
9-10 (2500 kg of lime/fed	10.6	11.52	11.5	12.65	11.56
Overall mean	10.28	11.51	11.4	12.77	11.49
L.S.D at 5%	pH 0.14	Biof. 0.14		Inter. 0.29	
2000/2001 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	8.65	9.70	9.50	11.60	9.86
7-8 (1500 kg of lime/fed	9.37	10.35	10.27	11.95	10.48
8-9 (2000 kg of lime/fed	10.20	11.55	11.27	13.85	11.71
9-10 (2500 kg of lime/fed	9.77	10.80	10.40	12.35	10.83
Overall mean	9.50	10.60	10.36	12.43	10.72
L.S.D at 5%	pH 0.14	Biof. 0.14		Inter. 0.29	

Table (7) : Effect of soil pH and biofertilization on number of Grains per spike of Sakha 69 wheat variety irrigated by sewage water in 1999 / 2000 and 2000 / 2001 seasons.

1999/2000 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	41.35	53.85	53.77	54.85	50.95
7-8 (1500 kg of lime/fed	42.62	54.97	54.70	56.22	52.13
8-9 (2000 kg of lime/fed	44.95	56.00	55.00	58.85	53.73
9-10 (2500 kg of lime/fed	43.30	54.20	53.90	55.30	51.67
Overall mean	43.05	54.75	54.38	56.30	52.12
L.S.D at 5% pH 0.38 Biof. 0.38 Inter. 0.76					
2000/2001 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	43.50	45.20	45.30	48.30	45.57
7-8 (1500 kg of lime/fed	45.32	47.35	47.32	50.32	47.58
8-9 (2000 kg of lime/fed	46.45	51.35	51.30	55.42	51.13
9-10 (2500 kg of lime/fed	45.15	48.12	48.25	51.95	48.36
Overall mean	45.10	48.00	48.04	51.50	48.16
L.S.D at 5% pH 0.17 Biof. 0.17 Inter. 0.34					

Table (8) : Effect of soil pH and biofertilization on grain weight per plant in gram of Sakha 69 Wheat variety irrigated by sewage water in 1999 / 2000 and 2000 / 2001 seasons.

1999/2000 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	1.63	1.96	1.96	2.11	1.91
7-8 (1500 kg of lime/fed	1.86	2.09	2.09	2.30	2.09
8-9 (2000 kg of lime/fed	2.03	2,33	2.31	2.73	2.35
9-10 (2500 kg of lime/fed	1.91	2J3	2.13	2.25	2.11
Overall mean	1.86	2.13	2.12	2.35	2.11
L.S.D at 5% pH 0.02		Biof : 0.02		Inter. 0.03	
2000/2001 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	1.84	2.03	2.03	2.31	2.05
7-8 (1500 kg of lime/fed	2.04	2.19	2.19	2.54	2.24
8-9 (2000 kg of lime/fed	2.23	2.47	2.46	2.81	2.49
9-10 (2500 kg of lime/fed	2.06	2.30	2.29	2.55	2.30
Overall mean	2.04	2.25	2.24	2.55	2.27
L.S.D at 5% pH 0.03		Biof. 0.03		Inter. 0.06	

Table (9): Effect of soil pH and biofertilization on grain yield (gm.)/plot of Sakha 69 wheat variety irrigated by sewage water in 1999 / 2000 and 2000 /2001 seasons.

1999/2000 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	3551.25	3596.25	3582.00	3613.25	3585.68
7-8 (1500 kg of lime/fed	3588.25	3660.75	3660.50	3701.00	3652.62
8-9 (2000 kg of lime/fed	3665.75	3715.00	3715.25	3808.00	3726.00
9-10 (2500 kg of lime/fed	3592.50	3666.00	3654.25	3718.75	3657.87
Overall mean	3599.43	3659.50	3653.00	3710.25	3655.54
L.S.D at 5% pH 5.75		Biof. 5.75		Inter. 11.50	
2000/2001 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Bioeea**	**Nitroben**	**Mean**
6-7 (Control)no lime added	3602.50	3673.75	3667.00	3711.00	3663.56
7-8 (1500 kg of lime/fed	3656.00	3695.25	3689.25	3756.50	3699.25
8-9 (2000 kg of lime/fed	3685.50	3738.50	3742.50	3829.75	3749.06
9-10 (2500 kg of lime/fed	3664.25	3704.25	3702.25	3769.50	3710.06
Overall mean	3652.06	3702.93	3700.25	3766.68	3705.48
L.S.D at 5% pH 2.56		Biof. 2.56		Inter. 5.13	

Table (10) : Effect of soil pH levels and boifertilization on grain yield / feddan in ardab of Sakha 69 wheat variety irrigated by sewage water in 1999 / 2000 and 2000 /2001 seasons.

1999/2000 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	9.43	9.76	9.94	10.08	9.80
7-8 (1500 kg of lime/fed	9.60	10.39	10.37	10.90	10.31
8-9 (2000 kg of lime/fed	10.68	10.81	11.08	11.88	11.11
9-10 (2500 kg of lime/fed	9.82	10.56	10.56	10.79	10.43
Overall mean	9.88	10.38	10.49	10.91	1042
L.S.Dat5% pH 0.14		Biof. 0.14		Inter. 0.27	
2000/2001 season					
Soil pH levels by adding lime	**Biofertilizers**				
	Control	**Cerealin**	**Biogen**	**Nitroben**	**Mean**
6-7 (Control)no lime added	9.40	9.80	9.68	10.24	9.78
7-8 (1500 kg of lime/fed	9.60	10.36	10.27	11.02	10.31
8-9 (2000 kg of lime/fed	10.23	10.98	11.03	12.00	11.06
9-10 (2500kg of lime/fed	9.64	10.39	10.34	11.12	10.37
Overall mean	9.72	10.38	10.33	11.09	10.38
L.S.D at 5% pH 0.02		Biof. 0.02		Inter. 0.05	

Table (11): Effect of soil pH levels and biofertilization on concentration of heavy metals (ppm) in grain of Sakha 69 wheat variety irrigated by sewage water in 1999 / 2000 season.

pH	Treatment	Zn (ppm)	Cd (ppm)	Pb (ppm)	Ni (ppm)	Co (ppm)
6-7	Control	45.70	0.260	6.95	14.61	0.750
	Cerealine	55.15	0.270	6.98	15.23	0.800
	Biogen	56.30	0.280	7.76	16.85	0.965
	Nitrobin	58.05	0.400	9.66	21.17	1.710
7-8	Control	39.40	0.210	6.22	11.84	0.610
	Cerealin	39.50	0.215	6.44 <	11.91	0.645
	Biogen	41.50	0.215	6.57	12.56	0.60
	Nitrobin	42.60	0.24S	6.66	14.20	0.710
8-9	Control	35.45	0.185	5.75	6.61	0.510
	Cerealin	35.50	0.185	5.97	9.18	0.515
	Biogen	36.75	0.190	6.04	10.33	0.555
	Nitrobin	38.80	0.195	6.10	11.66	0.565
9-10	Control	32.05	0.100	3.23	0.00	0.335
	Cerealin	33.15	0.110	4.15	0.00	0.360
	Biogen	34.10	0.155	4.59	0.00	0.445
	Nitrobin	34.20	0.170	4.72	2.71	0.500

Table (12): Effect of soil pH levels and biofertilization on concentration of heavy metals, (ppm) in grain of Sakha 96 wheat variety irrigated by sewage water in-2000 / 2001 season.

pH	Treatment	Zn (ppm)	Cd (PPm)	Pb (ppm)	Ni (ppm)	Co (Ppm)
6-7	Control	45.60	0.885	7.168	18.430	0.215
	Cerealin	46.90	0.935	7.218	20.400	0.220
	Biogen	56.30	1.080	7.388	21.730	0.220
	Nitrobin	55.80	2.540	9.353	21.750	0.325
7-8	Control	37.20	0.635	6.308	12.470	0.185
	Cerealin	37.65	0.635	6.583	12.585	0.190
	Biogen	38.85	0.775	6.588	13.020	0.195
	Nitrobin	39.30	0.795	6.653 (	16.395	0.195
8-9	Control	34.10	0.545	5.848	2.570	0.150
	Cerealin	34.90	0.550	6.013	5.070	0.160
	Biogen	35.20	0.565	6.178	7.385	0.175
	Nitrobin	35.20	0.630	6.168	9.335	0.180
9-10	Control	25.20	0.435	4.093	0.000	0.100
	Cerealin	28.35	0.545	5.408	0.000	0.110
	Biogen	32.60	0.505	5.568	0.000	0.130
	Nitrobin	33.80	0.515	5.578	2.145	0.145

photosynthesis and vice versa (FAO, 1992). Or may be attributed to soil pH decreases, heavy metals increases concentration inside cell, consequently, enzymestoxic. These results are agreement with those reported by Olivar *et al.,* (1996), Sobhi (1996), Paula *et al.,* (1997) and Zakaria (2000).

B- Effect of biofertilization :

Data in tables (6), (7), (8), (9) and (10) indicated that, biofertlization had positive significant effect on all studied characters the highest values for this characters were produced from fertilization by Nitroben in both seasons, while, the lowest values were obtained treatment. These results may be due to the fact that Nitroben contains by control biological nitrogen fixation strains, the interaction of gives more efficiency than the fertilizers containing only one biological nitrogen fixation strain. This seems to apply to all the results discussed below. That the results were in agreement with caceres et al., (1996 a, b), Badawy et al., (1997), Fares (1997), Abd Allah *et al.,* (1998), Aly *et al.,* (1999) and Woodard and Bly (2000).

C-concentration of heavy metals in wheat grains of.

Data presented in tables (11 and 12) show that increasing soil pH levels decreased concentration of heavy metals by different percentages (%) in wheat in two seasons. These results indicated that using sewag water in soil alkalescent or alkali for irrigation had no toxic level in plant. These results may be due to that increasing soil pH decreases heavy metals absorption in the plant. Similar results were obtained by olivar *et al.,* (1996) and paule *et al.,* (1997).

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الملخص العربى

تأثير التسميد الحيوي على إنتاجية القمح تحت ظروف الري بمياه الصرف الصحي المعالجة

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أجريت تجربتان حقليتان بمزرعة الجبل الأصفر بالقليوبية خلال موسمي الزراعة ١٩٩٩/٢٠٠٠ ، ٢٠٠٠ / ٢٠٠١ لدراسة تأثير مستويات pH التربة والتسميد الحيوي على صفات النمو والمحصول وتركيزات المعادن الثقيلة في محصول القمح صنف سخا ٦٩ . وكانت معاملات pH التربة كما يلي : الكنترول (٦-٧) بدون إضافة جيرٍ زراعي ، (٧-٨) بمعدل إضافة ١٥٠٠ كيلو جرام جير / فدان ، (٨-٩) بمعدل إضافة ٢٠٠٠ كيلو جرام جير / فدان ، (٩-١٠) بمعدل إضافة ٢٥٠٠ كيلوا جرام جير / فدان ومعاملات التسميد الحيوي وهى الكنترول (بدون تسميد) وإضافة السريالين أو البيوجين أو النتروبين .

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى :

أوضحت النتائج أن هناك تأثيراً معنوياً لكل من الـ pH والتسميد الحيوي على كل الصفات المدروسة وهى : عدد الأشطاء / نبات وعدد الحبوب / سنبلة ووزن حبوب النبات بالجرام ، محصول حبوب القطعة بالجرام ، محصول حبوب الفدان بالأردب . وكان أحسن مستوى pH هو (٨-٩) مع التسميد الحيوي النتروبين.

أدت زيادة pH التربة إلى خفض تركيزات المعادن الثقيلة وهى الزنك والكادميوم والرصاص والنيكل والكوبلت في حبوب القمح في موسمي النمو وكانت تلك التركيزات داخل الحدود المسموح بها في الحبة.

أوضحت النتائج أن هناك تأثيراً معنوياً للتفاعل على كل الصفات المدروسة خلال موسمي النمو. ومن خلال النتائج يمكن أن نقول أن أحسن معاملات هذه الدراسة تحسيناً للنمو وإنتاجية القمح كانت بين مستوى pH التربة ٨-٩ مع السماد الحيوي النتروبين كما يمكن الحصول على أقل تركيز للمعادن الثقيلة في حبوب القمح تحت ظروف الري بمياه الصرف الصحي المعالجة عند مستوى pH التربة ٩-١٠ مع الكنترول (بدون استخدام سماد حيوي).