Egypt. J. Soil Sci. **47**, No.3, pp.263-280 (2007)

Effect of Organic Manure and Biofertilizers on Wheat Grown in Lacustrine Soil as Compared with Mineral Fertilizers

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A FIELD experiment was conducted in the growth saesons 2004/ 2005 and 2005 / 2006, at Soil Salinity Laboratory , El-Sabahia (Abis) Alex., Egypt to, investigate the efficiency of organic manure (compost), bio – fertilizers and mineral fertilizers on the growth and yield components of wheat plant (*Triticum aestivum* L., Sakha 93) grown an lacustrine soil also to eveluate these different fertilizers effects on soil fertility . The experiment was laid out in a split plot design with three replicates . The main plots included four treatments: control (C) organic manure (O. M) mineral fertilizer (M . F), 50% O.M + 50% M.F (O.M.F) and the sub – plots inculded four sub – main treatments : control , N-fixing bactria (NB), P – dissolving bactria (PB) and the mixed of 50% NB + 50% PB (NPB) . Organic manure was added before cultivation at a rate of 120 N units / Fed. Biofertilizer treatment included inoculation of wheat seeds with NB , PB or mixture of both (NPB) in addition to the control (C) .

The results showed that soil EC significiantly deceased with application of organic manure , but it was not significantly affected either bio-or by mineral fertilizers treatments in both seasons . Results showed that soil CEC were increased in both seasons due to MF , OM and OMF traetments . The best results were obtained for OMF and OM (103.3, 102.8 Cmol/Kg for the first season and 103.18 and 102.5 Cmol / kg with biofertilizers NPB) .The data also showed significant increasing of Av-N, Av-P and Av-K in the soil by bio-fertilizers application compared with the non-inoculated (control) in both season . The inraction between bio- minral fertilizers and O . M (Bio – OM –MF and OMF) showed significant effect on Av-N, P and K in both seasons . The highest values were oblained with applying OMF + NPB treatments (36.9 and 64.1 ppm for Av-N , 32.5 , 35.75 ppm for Av-P and 98.1 and 101.2 ppm for Av-K) . The obtained results indicated that , yield and yield components (plant height , spikes length , number of grains / spike , straw yield , grain yield) as well as crude protein, phosphorus and potassium percentages in wheat grain significantly increased due to mineral and / or organic manure (compost) as well as bio-fertilizers treatments . Application of O.M. and mineral fertilizers (as 50 % and 50 % of both bio-fertilizers " N-fixing bacteria and P-dissolving bacteria"), 1000 grain weight significantly increased in both seasons. The percentage increases of grain yield were about 48.28 % and 53.3 % for the biofertilizers (NPB)

and the mixutre of O.M and mineral fertilizers (OMF) in both seasons , respectivrely . The percentages of crude protein , P and K in wheat grains were significantly increased by application of the combined treatments of O.M + Azotobactrin Bacillus megatrium mixture . Combination of inorganic , organic and biofertilizers show produced the highest growth and yield components .

Keywords : Organic manure , Biofertilizers mineral , Wheat , Sakha 93 , Lacustrine soil, Azotobacterin bacillus, Megaterium .

Saline soils , which not are previously ulilized in agriculture , are becoming more important as new land in due to meet the demands of an increasing popultion or to replace land lost to urban development . Avoiding the risk of soil and / or water slinity , a fair number of investigations were conducted using elemenal sulpher and organic manure (Wassif *et al.,* 1995) . The farmers usually use excessive a mounts of chemical ferlilizers to maxinize their yields. On the other hand , most of mineral N is of a potential pollution by NO_3^- losses in the groundwater, which affected human and animal health (Sarhan *et al.,* 2002), So sustainable farming such as organic agriculture or using microirganisms (Biological agriculture) as biofertilizers in agriculture is considered to be a strategy to preserve the enviroment and prevent pollution. Several reports have affirmed positive plant growth response after inoculation with different non – symbiotic N – fixing bacteria such as Azotobatar spp (Hassan *et al.,* 1985), Azospirillum brasilense (Beltensperger *et al.* , 1987) and Klebsiella pneumonias (Hassan *et al.,* 1985). Oken (1982) stated that inoculated plants with biofertilizers exhibited about 30 - 50 % greater uptake of nitrogen, phosphorous and potassium than non – inoculated plants . He suggested that associative nitorgen fixing enhanced the mineral absorption by cell cortex , which is reflected on the plant growth and yield increase. Although many management practices have been recommended to render salt - affected soil suitable for crop production , the alternative biological approch has been considered an economical, feasible and efficient means of overcoming salinity problems (Anonymous 1998 – 2003) . The complete or partial replacement of NPK mineral fertilizevs by the use of more safe and economical organic fertilizers is strongly recommended (Gagnon *et al.,* 1997; Hegde *et al.,* 1999 and El-kouny *et al.,* 2004). Several authors pointed out the capability of organic manure for improving growth , and / or production of cereal (El-Sersaway *et al.,* 1997). Studies comparing soils of organiclly and conventionally managed farming systems have documented higher soil organic mater (O M) and total N with the use of organic practice (Werner , 1997) .Ott (1990) observed a yield increased due to farmyard manure addition of 25% to 35% relative to mineral fertilization for a 5-yr rotations with spring wheat . Soliman and Abdel – Momen (1995) found significant increase in dry matter of inoculated maize with azotobacter that received half dose 148.2 KgN ha^{-1} of nitrogen fertilizer when compared with uninoculated maize which received full dose. They found that N-uptake was increased by 124% due to inoculation and application of 2% farm manure as compared with uninoculated

maize and no addition of farm manure . Khadr *et al.* (2002) reported that soil O.M. has effected soil chemical, physical and biological properlies that in turn contributed to improve crop yield. The objectives of this work , therefor were to investigate the efficiency of organic manure (compost), biofertilizers and mineral fertilizers on the growth and yield components of wheat plants (*Triticum aestivum* – L .) Sakha 93 grown in lacustrine soil and its effects on soil fertility .

Material and Methods

A field experment was conducted at Soil Salinity Lab ., El-Sabahia (Abis) Alex, Egypt , for two growing successive seasons 2004/2005 and 2005/2006 to study the efficiency of organic manure (compost) and bio – fertilizers, in comparsion with mineral fertilizers, on both the growth of wheat plant and the soil fertility .

Preparation of organic manure (O.M.)

The preparation of organic manure (compost) was carried out in Soil Salinity and Alkalinity Res. Lab. (El – Subahia , Abis) Alex . The preparation of organic materials used were animal manure , plant residues and poultry manure at a ratio of 4:4:1, respectively . Fertilizers sources and biological activators were added to enrich the nutritional value of the O.M . These materials were heaped mechanically in windrow shape of 1.5m length . Horn meal (T- N equals 14%) and fishmeal (T– N equals 7.5%) were added to make T-N equals 2% in the heap . Bone meal (T-P equals 13%) and rock phosphate (T -P equals 13.01) were added to make T - P 1% in the heap . Potassium sulphate (T - K 48.6%) and basalt (T - K equals 1.5%) were added to make T – K equals 1% in the heap . These materials were added at the beginning of composting process . At composting cooling period the biological activators (Azotobactrin , mychrobin , Nitrobin and phosphorin) at a rate of 400 gm/heap were added . The heap was watered to reach 50-60% of the WHC and subjected to mixing for three times . The composting period was for 90 old (El-Kouny, 1999) . The compost analysis was carried according to Bertran & Andreas, 1994 and El-Kouny, 1999 . The data obtained are given in Table 3 .

Experimental Layout

The filed experiment was laid out in a split plot design with three replicates . The main plots included four treatments : Control (C) , organic manure (O . M) , mineral fertilizer (M . F) or 50% O . M + 50% M . F (O . M . F) , while the subplots inculded four submain treatments : control , N fixing bactria (azotobacter chroococum, NB), P– dissolving bactria (Bacillus megaterium phosphaticum bactria , PB) and mixture of 50% NB + 50% PB (NPB) . Organic manure treatment (compost) was added before cultivation at the rate of 120 N unit / Fed . The biofertilizer treatment included the inoculation of wheat seeds with NB (N – fixing bactria), PB (P – dissolving) or mixture of both cultures (NPB) in addition to the untreated control plants (C). Mineral fertililzers treatments were added at two batches : 30 and 75 days from

sowing and at the rate of 120 N units/Fed . (ammonium sulphald 20.6% N) 40 P_2O_5 units /Fed . (superphosphate 15.5% P_2O_5 and 50 K_2O units/ Fed. (potassium sulphate 48.5 K_2O). Wheat (*Triticum aestivium* L.) cultivar Sakha 93 was seeded (65kg / Fed) and normal agricultureal practices were applied . The plot area was 12 m^2 size (3 m x4m) .

Soil sampling and analysis

Soil samples (0- 25 cm) were collected , air – dried , ground and passed through a 2 mm sieve . These samples were prepared for the determination of bluk density (Db) and water holding capacily (WHC) as described by Wright (1954) , pH (1 : 2.5 soil : water) using glass – electrodes pH – meter. The electrical conductivity (E C) of the saturated extract of soil paste and water soluble cations and anions were determined in the extract of the saturated soil paste (Richards, 1954). Available P (Av-P) was extracted by 0.5 N $NaHCO_3$ at pH 8.5, by Olson method and determined colorimetrically (Jackson, 1958). Organic matter was determined by Walkly & Black (1982) method and total N by Kjeldahl method (Jackson, 1967). The percentage of total carbonate was determined volumetrically using collin's calcimeter (Black *et al.*, 1965) . The amunt available N (Av-N) and K (Av-k) were determined as outlined by Black *et al.* (1965). Cations exchangable capacity (CEC) were determined according to Page *et al* . (1982). The main soil characteristics are shown in Tables 1 and 2. At harvesting stage , soil samples were taken, from each treatment for the determination of the different chemical properties of soil .

Plant sampling and analysis

At harvesting stage, samples of plants were collected and the following parmeters were determined : plant height in cm, spike length in cm, number of grains / spike , weigth of grains /spike in gm, 1000 grains weigth in gm , grain yeild (GY) Kg/Fed and straw yield (SY) ton / fed . The Nitrogen content in grains was determined by micro-kjeldahl as described in A.O.A.C (1970) and protein content was obtained by multiplied 5.7 with N percentage of grains . Phosphorus and potassium contents in garins were determined as described by Jakson (1967) .

Statistical analysis

Standard indiviual and combined analysis of variance over two seasons using LSD were performed to estimate the significant differences among treatments and ineractions (Steel & Torrie , 1980).

Result and Discussion

Tables 1 and 2 showed that the used soil has relatively high amount of total carbonate and low amount of organic matter , available P and K . It is non – saline with low SAR value . There is no marked variations in the physical properties of soils collected in 2004/2005 and 2005/2006 growing seasons. However , there are marked variations in the chemical properties of the soil for samples collected in the first and the seconed season . Table 3

shows that the used organic manure (O . M .) has low pH (6.65), suitable C / N ratio (14.3) and high amounts of available macro and micro nutrients .

TABLE 1. The physical properties of the soil used .

Growig season	Parlical size distribution			Texture class	Water holding capacity, %	Bulk density, gm/cm^3	Total carbonat, %
	Sand	Silt	Clay				
2004/ 2005	16 .0	24.5	59.5	Clay loam	35.0	1.62	7.50
2005/2006	15.2	25.0	59.8	Clay loam	36.0	1.65	7.4

TABLE 2.The chemical analysis of the soil used .

Growig season	EC(dSm^{-1})	PH (1:2.5)	Cations (Meq/L)				Anions (Meq/L)			O.M%	CEC , C mol / Kg	Av-N , ppm	Av-P , ppm	Av-K,ppm
			Na^+	K^+	Ca^{+2}	Mg^{+2}	HCo^-	Cl-	$So4^{-2}$					
2004/ 2005	2.8	8.27	16.9	1.9	6.3	2.9	4.8	17.6	5.6	1.98	60.5	22.0	11.0	70.0
2005/2006	2.33	7.75	14.05	1.95	4.3	3.00	3.1	15.1	5.1	2.25	82.64	44.65	23.44	89.18

TABLE 3. The characteristies of the organic manure (compost) used in this study.

Dry matter, %	Bulk density, kg/m^3	PH*	EC * (dSm^{-1})	T-N, %	T-C, %	C/N ratio	T-P, %	T-K, %	CEC, Cmol / kg	DTPA exracted element (ppm)			Cl, %	Na, %
										Fe	Mn	Zn		
84.48	655	6.65	3.25	3.25	46.5	14.31	2.05	2.15	218	980	455	150	0.18	0.19

* measured in 1:10 O.M – water ratio .

Soil chemical properties after harvest

Table 4 showed that the EC significantly decreased , in conformity SAR , with application of organic manure, but it was not significantly affected by either bio- or by mineral fertilizers treatment in both two seasons . In regard to organic manure (OM) and mixture of OM + FM the OMF gave significantly lower values for soil and SAR than those untreated soil (control) . The lowest values of soil EC (2.07 & 2.18 and 2.1 & dSm^{-1} for the first and second season , respectively) were found with OFM and OM application to the same trend occurred for SAR in both two seasons . These results agree with those obtained by Wasif *et al* . (1995); El-Kouny (1999) and El-Kouny *et al.* (2004) . Concerning the interaction between organic / mineral treatments and biofertilizer, this interaction was significant for EC and SAR in the seasons (Table 4) . However, there were no significant differences between mixed biofertilizer (NPB), NB and PB + mineral treatment , which gave the lowest results and those of NPB , NB and PB + organic manure (O . M) mixed OM + MF (OMF) treatments (1.82dSm^{-1} for first season and 1.9 & 2.05 dSm^{-1} for second season . while for SAR values were 11.3& 12.22 for first season and 11.66 & 11.5 for second season . This effect is in aggreement with the use reopred Wasif *et al* . (1995) and El–Kouny *et al.* (2004) .

Table 4 also showed that CEC values had imcreased in both seasons due to the use of mineral, organic and mixed of organic with mineral treatments . The best results for this trait was those of O.F.M. fertilization as well as, those of O.M then mineral fertilization . There are three treatments showed significant higher values than control treatments in both two seasons (99.2, 95.69 and 69.04 Cmol/kg for first season and 99.98, 96.05 and 69.38 Cmol/ kg for second season). Similar results was indicated by Mahmuod (2000) . In regard to NPB , biofertilization treatments NB, PB and NPB gave higher values for CEC than those of untreated treatment . The highest values were those of NPB treatment in both seasone as clearly shown in Table 4 and were 87.76 , 81.70 Cmol / kg for first season and 87.25 & 83.05 Cmol / kg for second season . Similar results were obtained by El- Kouny (1999) and El -Kouny *et al.* (2004). Concerning the interaction between organic mineral treatments and biofertilizer treatments , it was significant for CEC in both two seasons . The higher valuves for CEC were 103.3 and 102.8 Coml / kg for O.M .F + NPB and OM + NPF tratments in first season respectively , while the second season were 103.18 . 102.5 Cmol / kg for O . M + NPB and O . F . M + NPB treatmcnts, Table 5 showed the amount of available nitrogen (AV–N) phosphorus (AV-P) and potssium (AV- k) as affected by biofertilizer, mineral fertilizer and organic manure in two seasons. Analysis of variance revealed signifcant effects of biofertilizer (especially NPB) and organic manure . Table (5) showed significant increases in the amonts of Av-N , Av- P and Av-K as compared with the non – inoculated control in both two seasons .

TABLE 4.Values of EC (dSm^{-1}) ,SAR and CEC (C mol / kg) of the soils cultivated with wheat as affected by O. M., biofertilizers and mineral fertilizers during two successive seasons .

Soil parameters	EC (dSm^{-1})									
Season	2004/2005					2005/2006				
Treaments	Biofertilizers					Biofertilizers				
Compost and mineral fertilizers	C	NB	PB	NPB	Mean	C	NB	PB	NPB	Mean
C	2.8	2.4	2.6	2.45	2.56	2.75	2.45	2.65	2.4	2.56
O.M	2.3	2	2.1	2	2.18	2.35	2.1	2.15	2.05	2.16
M.F	2.76	2.3	2.5	2.25	2.45	2.7	2.35	2.55	2.4	2.5
O.M.F	2.31	2	2.15	1.8	2.07	2.31	2.1	2.1	1.9	2.1
Mean	2.42	2.18	2.34	2.15	2.27	2.52	2.25	2.36	2.20	2.33
$L.S.D_{0.05}$	Bio – fertilizer			n.s				n.s		
	Compost and mineral			0.3				0.28		
	Intraction			0.19				0.2		
SAR										
C	15.71	13.48	14.59	13.75	14.37	15.43	13.75	14.87	13.47	14.37
O.M	12.9	12.22	12.72	12.22	12.14	12.19	11.72	12.07	11.5	12.12
M.F	15.13	12.9	14.03	12.63	13.75	15.15	13.19	14.3	13.48	14.03
O.M.F	12.96	12.22	12.06	11.3	11.62	12.96	12.72	11.72	11.66	11.72
Mean	13.72	12.23	13.13	12.06	12.97	14.14	12.63	13.24	12.35	13.09
$L.S.D_{0.05}$	Bio – fertilizer			n.s				n.s		
	Compost and mineral			1.43				1.45		
	Intraction			1.7				1.72		
CEC (C mol / kg)										
C	60.5	65.8	64.25	69.75	65.08	61.75	66.7	63.5	68.9	65.13
O.M	90.5	95.25	94.2	102.8	95.69	91.1	96.5	93.5	103.1	96.05
M.F	65.2	67.5	68.2	75.25	69.04	66.1	67.9	69	74.5	69.38
O.M.F	96.2	98.25	99.1	103.25	99.2	97.1	101.1	99.2	102.5	99.98
Mean	78.1	81.7	81.44	87.76	82.25	79.01	83.05	81.25	87.25	82.64
$L.S.D_{0.05}$	Bio – fertilizer			4.95				4.75		
	Compost and mineral			5.1				5.05		
	Intraction			4.25				4.15		

C = control , O . M = organic manure , M .F = mineral fertilizer
OMF = mixture of OM + MF .

The obtained data indicated that application of biofertilizers NB – PB and NPB increased Av – N with about 55.4% , 39.24% , 51.75% and 52.23% 50.53 , 52.13% for first season and second season , respectively , for Av – P with about 108.84% , 113.25 % , 112.42 % and 71.66 %, 114.56 % and 102.82 % for the

first and second season , respectively and for Av – k with about 10.07% 13.46%, 15.69% and 20.44% , 9.46% , 16.50% for first and second season, respectively , compared to non – inoculated control . The biofertilizers suggested that phosphate solubilizing microorganisms are preferentially stimulated in the rhisosphere which are greatly improtant for plant growth (Subba Rao ,1984) . It was found that N – fixing bacteria increased N assimilation by plants and enhanced mineral uptake and improved root growth (Hegde *et al.* , 1999) .

Table 5 showed that application of O .M . , M . F . and O.M .F . significantly increased the amonts of Av-N, Av-P and Av-K in both two seasons . The best results for such three traits were those of O.M.F fertilization as well as , those of mineral fertilization (M.F), final O.M fertilization . These three treatments gave higher precentage of Av-N, Av-P and Av-K than control (untreated soil) . This may be due to the decomposition of organic manure which supplied more available nutrient elements and formation of organic and inorganic acids during decomposition which slightly reduce the soil pH which affected the solubility and availability of N, P and K . This benefical effects is in agreement with those reported by Wassif *et al.* (1995) and El – Kouny *et al.* (2004). It is clear from the obtained data that the interaction between bio, mineral fertilizer and organic manure (bio, O.M., F.M. and O.F.M.) had significant postive effect on Av-N , P and K in both two seasons . Av-N was the highest with applying the OMF + NPB treatment (63.9 and 64.1 ppm for the first and second season respectively) . The highest Av-P was obtained with the M.F + NPB (35.5 ppm) and O.M .F + NPB (35.75 ppm) for first and second season , respectively . Concerning the Av-K gave the highest values with OMF + NPB (98.1ppm) and 101.2 for first second season respectively (Mohmoud , 2000 and Khadr *et al.*, 2002) .

Plant growth characters

Table 6 showed the main effects of O.M., biofertilizers and mineral fertilizers on plant height and spike length of wheat . The best rseults for two such two traits were those of 50% organic manure + 50% mineral fertilizers (O.M.F) , as well as , those of the mineral replacement (NPB and NB of biofertilizers , respectively) . These treatments gave significantly higher values than control plants, but no significant differences being obtained among them . These results are confirmed by the finding of Huggins & Pan (1993) and Sarhan *et al* . (2002).

Concerning the biofertilization treatments NB , PB and NPB gave significantly higher values for plant and spike length than those of mixed culture treatment in both seasons as clearly shown in Table 4. In harmony with these results those revealed by Subba Rao (1984); Hegde *et al* . (1999) and Ibrahim (2000) . In regard to interaction between organic / biofertilizer and mineral teratments , it was significant for plant height in the two seasons. It was found that significant differences were dectected between mixed fertilizer treatment + O. M . or M .F and O.M.F treatments , which gave the best results and those of mixed biofertilizer treatment + O . M . F treatment .

TABLE 5. Amount of available N,P and K in Soil cultivated with wheat as affected by O. M., biofertilizers and mineral fertilizers during two successive seasons .

Soil parameters	Av-N,ppm									
Season	2004/2005					2005/2006				
Treaments	Biofertilizers					Biofertilizers				
Compost and mineral fertilizers	C	NB	PB	NPB	Mean	C	NB	PB	NPB	Mean
C	22	30.2	28.5	33.1	28.45	22.1	31.3	27.95	34.2	28.98
O.M	40.2	45.5	41.15	49.2	44.03	41.1	46.2	41.12	50.7	45.03
M.F	41.50	49.1	43.7	54.7	47.25	42.1	50.2	48.1	59.1	49.88
O.M.F	43.60	62.9	46.2	63.9	54.15	43.8	63.1	48.2	64.1	54.8
Mean	36.83	46.93	39.89	50.23	43.47	37.53	47.7	42.09	52.03	44.65
$L.S.D_{0.05}$	Bio – fertilizer		2.05			2.10				
	Compost and mineral		3.40			3.65				
	Intraction		3.75			3.85				
	Av-P,ppm									
C	11	9.2	12.75	13.2	11.54	11.2	10.2	13.25	14.2	12.21
O.M	20.3	18.2	29.3	30.25	24.51	20.5	18.1	31.5	30.75	25.21
M.F	21.5	22.1	32.5	35.5	27.9	20.1	21.5	33.75	34.5	27.46
O.M.F	25.1	27.2	34.2	33.2	29.93	24.2	20.25	35.2	35.75	28.85
Mean	19.48	19.18	27.19	28.04	23.47	19	17.51	28.43	28.8	23.44
$L.S.D_{0.05}$	Bio – fertilizer			0.80				0.75		
	Compost and mineral			2.75				2.85		
	Intraction			1.20				1.35		
	AV-K,ppm									
C	70	72.5	79.4	80.1	75.5	70.1	72.6	82.25	81.75	76.68
O.M	80.5	86.2	95.25	96.21	89.54	86.2	88.5	90.2	99.25	91.04
M.F	85.2	89.5	90.5	96.25	90.36	88.25	81.9	92.6	98.75	92.88
O.M.F	90.5	94.2	95.2	98.1	94.5	91.2	96.75	95.15	101.2	96.08
Mean	81.55	85.6	90.09	92.67	87.47	83.94	87.44	90.05	95.24	89.18
$L.S.D_{0.05}$	Bio – fertilizer			5.3				5.75		
	Compost and mineral			4.0				4.40		
	Intraction			4.2				4.25		

C = control , O . M = organic manure , M .F = mineral fertilizer

OMF = mixture of OM + MF .

TABLE 6. Wheat plant height (cm), spike length in cm , number of spike per m^2 of wheat as affected by O.M. biofertilizers and mineral fertilezers during two successive seasons .

plant parameters	Pant height									
Season	2004/2005					2005/2006				
Treaments	Biofertilizers					Biofertilizers				
Compost and mineral ofertilizers	Control	NB	PB	NPB	Mean	Control (C)	NB	PB	NPB	Mean
Control (C)	61.5	81.2	78.2	88.2	77.39	60.2	82.5	77.2	89.5	77.3
Compost (O.M)	90.5	99.5	95.2	102.5	96.96	91.3	99.9	94.1	100.2	96.4
M.F	107.2	110.2	106.2	117.2	110.2	106.2	112.2	105.2	119.5	110.82
O.M.F	112	118.5	115.2	122.2	117	105.2	116.5	111.5	123.5	114.2
Mean	92.85	102.3	98.7	107.5	100.6	90.73	102.78	97.0	108.7	99.8
$L.S.D_{0.05}$	Bio – fertilizer			7.5		7.3				
	Compost and mineral			10.3		10.1				
	Intraction			11.9		11.2				
Spike length in cm										
C	5.2	7.5	6.1	6.7	6.13	4.9	6.6	6.2	6.8	6.13
O.M	7.8	7.9	7.3	8.2	7.83	7.7	8.2	7.4	8.4	7.95
M.F	7.5	8.3	8.2	8.9	8.33	8.2	8.4	7.5	8.8	8.20
O.M.F	8.2	9.5	9.8	10.3	9.45	8.6	9.6	9.1	10.2	9.38
Mean	7.18	8.30	7.85	8.55	7.97	7.35	8.20	7.55	8.55	7.91
$L.S.D_{0.05}$	Bio – fertilizer			0.4				0.3		
	Compost and mineral			0.3				0.3		
	Intraction			0.5				0.5		

C = control , O . M = organic manure , M .F = mineral fertilizer
OMF = mixture of OM + MF .

Yield components

Data in Table 7 showed the main effect of biofertilizer , compost and mineral fertilizer on number of grains / spike and 1000 grains weight . Number of grains/ spike of wheat were affected by either biofertilizer NB or PB or NPB in both seasons and their conbineed analysis . Applying bio-fertilizers NB,PB and NPB sigificantly resulted in increasing the weight of grains/spike in the both seasons but these significantly increase were only obtained with NB and NPB in combined anailysis. Also, Table 7 indicated that NB,PB and NPB treatments considerably increased weight of 1000 grain over those of untreated plants . It may be due to biodynamic prepartion method and the wheat crop was able to compansate for unfavourable growth conditions by modified growth pattern . These results are in agreement with the results of Scheller *et al.* (1996). However, the highest values were those of mixed culture treatment in both seasons. Mineral fertilizer and organic manure gave significantly higher values for number of grains / spike weight of grains / spikes and 1000 grains weight thas those of untrezted plants . However, the NPB treatreatments which gave significant higher

values than those of mineral fertilizers and compost treatments (Huggins & Pan,1993 and Seheller *et al.*, 1996) . The interaction between mineral/ organic teatmants and biofertilizer was significant, in both seasons for number of grains / spike , weight of grains / spike and 1000 grains weight produced by the use of O.M + NPB treatment was siginifcantly equal to that produced by mineral treatment as shown in Table 7.

TABLE 7. Number of grains / spike , weight of grains / spike 1000 grains weight in gm of wheat as affectecl O.M., biofertilizers and mineral fertilizers two successive seasons .

Plant parameters	Number of grains / spike									
Season	2004/2005					2005/2006				
Treaments	Biofertilizers					Biofertilizers				
Compost and mineral ofertilizers	C	NB	PB	NPB	Mean	C	NB	PB	NPB	Mean
Control (C)	28	57	52	62	49.75	30	58	50	63	50.25
Compost (O.M)	40	64	59	69	58.0	47	63	57	72	59.75
Mineral fertilizer (M.F)	45	62	60	70	59.25	45	61	62	73	60.25
O.M.F	51	60	59	75	61.25	52	62	60	74	62
Mean	41.0	60.75	57.5	69	57.06	43.5	61.0	57.25	70.5	58.6
L.S.D $_{0.05}$	Bio – fertilizer			2.8		2.9				
	Compost and mineral			3.5		3.4				
	Intraction			4.2		4.3				
Weight of grains / spike in gm										
C	1.05	1.20	1.10	1.30	1.16	1.07	1.20	1.2	1.40	1.22
O.M	1.94	2.10	1.90	2.15	2.02	1.99	2.11	1.95	2.20	2.06
M.F	1.98	2.20	1.99	2.22	2.1	2.01	2.18	2.01	2.20	2.10
O.M.F	2.1	3.1	2.5	3.3	2.75	2.15	3.20	2.59	3.40	2.75
Mean	1.77	2.15	1.87	2.24	2.01	1.81	2.17	1.85	2.30	2.08
L.S.D$_{0.05}$	Bio – fertilizer			0.17				0.18		
	Compost and mineral			0.14				0.13		
	Intraction			0.2				0.20		

C = control , O . M = organic manure , M .F = mineral fertilizer .
OMF = mixture of OM + MF .

Grain and straw yields

Table 8 showed grain yield (GY) and straw yield (SY) as affected by biofertilizer (NPB), organic manure – (O.M .) and mineral fertilizer (M. F) in two seasons. Analysis of variance revealed significant effects of bio- fertilizer (especially NPB) and O.M .F. Addition biofertilizer NPB Significantly resulted in increasing grain and straw yields compared to the non inoculaled control in both studied seasons. Straw ylied of wheat was significantly affected by NB compared to non inoclated control. The obtained data indicated that addition of NPB increased grain yield with about 39.3 % , 46.2 % and 48.3 % for NB , PB and NPB, respectively in the first season and 41.3 % , 42.3 % and 33.3 % in the second seons compared to non – moculated control . These increases may be due to the ability of the microorganisms to produce growth regulatores substances, *i.e.*, indol acetic acid (IAA), Gibbrelic acid (GAS) and Cytokiniones (CK 3). These phytohorm- ones play an important role in plant growth through promoting photosunthesis and translocation and acculation of dry matter within different plants. This is in agreement with those obtained by Hassanein & Hassouna (1997) ; Hassouna & Hassanein (1997) and Gagnon *et al*. (1997). Aiso , data in Table 8 showed grain and straw yield of wheat were significantly increased with each O.M, M .F and O M F in both seasons . The precentage of increasing in grain yield due to fertilizer type : OM, MF and OMF were , respectively 16.67% , 11.18% and 19.44% for the first season and 10.39% , 14.04% and 26.87% for the second season .This might be due to the fact that nitrogen in fertilizer type (T-N for O.M F.M and O . F . M) were 3.25% , 20.5% and 50% from both them) , as an essential element plays a prominent role in building new cells and increasing phtosynthesis activity, which in consequences for the growth and yield parameters . These results are in a good line with those report by Hamissa & Moustafe (1998). Concerning the intertion between biofertilizers , mineral fertilizer and organic manure significant effect on grains and straw yield in two both seasons were obtained (Table 6) . The highest grain yield was obtained with NPB + O . M . F for both two seasons (2150 and 2300 kg / Fed) . Howere the highest straw yield was obtained with NB + MF for both two seasons too (4.95 and 4.90 ton / fed) .

Neutrients content of grains

Table 9 showed crude protein , phosphorus and potassium percentages in wheat grains as influenced by bio-fertilizers (NPB) organic manure (O.M) and mineral fertilizers (M.F.). Applying biofertilizers significantly resulted in increasing grains crude protein percentagcs compared to non incoulated control

TABLE 8. Grain yield (GY) kg/fed , straw yield (SY) ton /fed of wheat as affected by O.M., biofertilizers and mineral fertilizers during two successive seasons.

Plant parameters	Grain yield (GY) kg/fed									
Season	2004/2005					2005/2006				
Treaments	Biofertilizers					Biofertilizers				
Compost and mineral fertilizers	C	NB	PB	NPB	Mean	C	NB	PB	NPB	Mean
C	450	1400	1300	1450	1162.5	400	1380	1300	1500	1152.5
O.M	1500	1700	1500	1756	1612.5	1540	1750	1450	1700	1610
M.F	1700	1800	1750	1900	1787.5	1710	1780	1760	1950	1800
O.M.F	1800	1950	1900	2150	1950	1820	1950	1850	2300	1980
Mean	1362.5	1712.6	1612.5	1812.5	1628.75	1380	1690	1590	1862.5	1630.63
$L.S.D_{0.05}$	Bio – fertilizer			133.0		132.5				
	Compost and mineral			142.5		144.2				
	Intraction			165.2		166.1				
	Straw yield (SY) ton /fed									
C	0.49	2.75	2.10	2.25	1.90	0.510	2.30	2.08	2.80	1.91
O.M	3.1	3.95	3.75	3.70	3.60	3.15	3.60	3.80	3.90	3.61
M.F	3.95	4.95	4.75	4.80	4.60	3.90	4.90	4.50	4. 80	4.53
O.M.F	3.2	3.65	3.10	3.60	3.54	3.22	3.60	3.60	3.65	3.52
Mean	2.69	3.83	3.43	3.59	3.38	3.57	3.60	3.5	3.79	3.37
$L.S.D_{0.05}$	Bio – fertilizer			0.65		0.68				
	Compost and mineral			0.52		0.55				
	Intraction			1.1		1.15				

C = control , O . M = organic manure , M .F = mineral fertilizer
OMF = mixture of OM + MF .

TABLE 9. Crude protein%, P%and K% in grains of wheat as affected by O . M ., biofertilizers and mineral fertilizers during two successive seasons .

Plant parameters	Crude protein% in grains									
Season	2004/2005					2005/2006				
Treaments	Biofertilizers					Biofertilizers				
Compost and mineral fertilizers	C	NB	PB	NPB	Mean	C	NB	PB	NPB	Mean
C	8.10	9.75	9.75	10.25	9.46	8.15	9.80	9.70	11.30	9.74
O.M	11.23	11.90	10.75	11.99	11.47	11.20	11.80	10.20	12.9	11.30
M.F	9.25	9.75	9.15	9.75	9.48	9.20	9.85	9.20	9.90	9.75
O.M.F	11.1	11.95	11.25	12.0	11.58	11	12	11.30	12.25	11.64
Mean	9.92	10.84	10.23	10.99	10.50	9.89	10.86	10.1	11.36	10.60
L.S.D$_{0.05}$	Bio – fertilizer			0.40		0.40				
	Compost and mineral			0.42		0.43				
	Intraction			0.48		0.46				
P% in grains										
C	0.12	0.22	0.25	0.28	0.21	0.13	0.23	0.25	0.25	0.22
O.M	0.25	0.27	0.35	0.36	0.31	0.24	0.28	0.34	0.36	0.31
M.F	0.32	0.30	0.40	0.42	0.36	0.30	0.31	0.39	0.43	0.35
O.M.F	0.35	0.33	0.43	0.42	0.38	0.31	0.36	0.39	0.43	0.38
Mean	0.26	0.28	0.36	0.37	0.32	0.24	0.30	0.34	0.37	0.31
L.S.D$_{0.05}$	Bio – fertilizer			n.s				n.s		
	Compost and mineral			n.s				n.s		
	Intraction			n.s				n.s		
K% in grains										
C	0.20	0.29	0.29	0.36	0.29	0.19	0.3	0.29	0.35	0.28
O.M	0.29	0.35	0.32	0.4	0.34	0.28	0.36	0.32	0.42	0.37
M.F	0.3	0.37	0.35	0.42	0.36	0.29	0.38	0.36	0.4	0.35
O.M.F	0.33	0.39	0.36	0.42	0.38	0.34	0.38	0.37	0.42	0.38
Mean	0.28	0.35	0.33	0.4	0.34	0.28	0.36	0.34	0.40	0.34
L.S.D$_{0.05}$	Bio – fertilizer			n.s				n.s		
	Compost and mineral			n.s				n.s		
	Intraction			n.s				n.s		

C = control , O . M = organic manure , M .F = mineral fertilizer
OMF = mixture of OM + MF .

in both two seasons , on other hand , phosphorus and potassium percentage of wheat : grains werenot significantly affected by bio - fertilizeres to non-inoculated control in both two seasons in both two seasons . Crude protien was the highest precentages with applying the biofertilizers NPB were 10.99% and 11.36% for both growing seasons, recpectively .These results could be attributed to the high activity of N2 - fixing bacteria and / or mineral fertilization. Such activity and production of growth pormoting substances azotobacter may be responsible for imporvment curde protein precentage in wheat grain . These results are in agreement with those obtained by Hassan (1985); Oken (1982) and El-Sersawy *et al* .(1997) . The effect of organic manure (O.M) and mineral fertilizer (M.F .) were not influenced on phosphours and potassium precenage in wheat grains , but there were no significant effected for (O.M .) and (M.F.) on curde protein in wheat grains as shown in Table 9 in both two seasons . The highest precentage for curde protein was obtained due to OMF and O.M (11.58% and 11.47% in the first season and 11.64% and 11.30% in the second season, recpectively . These results in harmony with those obtained by Hamissa & Moustafa (1998) and Gagnon *et al.* (1997) . It is evident that curde protein was significatly by the interaction between organic manure, mineral fertilizer and biofertilizer in both seasons. On the other hand, phosphorus and potassium precentage in wheat grain were not affected by the interaction O.M., M.F. and biofertilizer in both seasons as shown in Table 9 . The highest precentage of curde protein was obtained with (OM F + NPB) and with (OM + NPB) treatments which were 12% & 11.99% in the first season and 11.64% & 11.30 in the second season . These results are in agreement with those obtained by Scafie & Bar-Yosef (1995) .

Conclusion

The benefical role of organic fertilization might be explained from the view point of improving soil physical , chemical and biological properties . These soil improvements have significant positive effects on wheat growth , yield and quality of wheat plants grown in lacustrine soil. Concerning biofertilizers, it was suggested that phosphate solubolizing micro-organisms was prefentially stimulated in the rhizosphere which are improtant for plant growth . It was found that N – fixing bactria increased N assimilation by plants , enhanced mineral uptake mineral root hairs growth and functions and stimulated the production of phytohormones IAA, GA3, cytokinin and elhylene.

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(*Received* 6/2007;
accepted 9/2007)

تأثير السماد العضوي والأسمدة الحيوية على محصول القمح المزروع في أراضي بحيرية بالمقارنة مع الأسمدة المعدنية

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أجريت تجربة حقلية في موسمين زراعيين متتاليين هما ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ في أرض معمل بحوث الأراضي الملحية و القلوية في الصبحية (أبيس) الإسكندرية لدراسة تأثير السماد العضوي (الكمبوست) والأسمدة الحيوية كبديل للأسمدة المعدنية على كلاً من خصوبة الأرض وعلى نمو نبات القمح (*Triticum aestiuum* L.) سخا ٩٣. استخدم التصميم الإحصائي قطع منشقة من الدرجة الأولى حيث كان السماد العضوي (OM) والسماد المعدني (FM) والخليط منهما (50% OM + 50% FM) تشكل القطع الرئيسية - بينما المخصب الحيوي الأول (مثبت الأزوت الجوي) (NB) – N-Fixing bactria- والمخصب الثاني (مذيب للفسفور) (PB) P- dissolving bactria والخليط منهم (50 % NB +50% PB) (NPB) تشكل القطع الشقية .

ويمكن تلخيص النتائج كالتالي :

- أشارت النتائج أن استخدام الأسمدة العضوية قد أدى إلى نقص معنوي في درجة EC في التربة وكذا نقص SAR بينما لم يحدث تأثير معنوي عند استخدام كل من السماد المعدني أو الأسمدة الحيوية خلال موسمي النمو .

- أوضحت النتائج زيادة قيمة CEC للتربة خلال الموسمين عند استخدام كل من OM، FM ، OFM وكانت أفضل النتائج عند استخدام اللقاح البكتيري NPB مع كل من O . F . M ، OM (103.3,102.8Cmol / kg) خلال الموسم الأول – أما الموسم الثاني فكانت (102.5 Cmol / Kg , 103.18) .

- دللت النتائج أيضاً على الزيادة المعنوية لكل من صور النيتروجين والفوسفور والبوتاسيوم الصالح (Av-N ، Av - P ، Av- K) في التربة بواسطة استخدام كل من الأسمدة الحيوية مقارنة بمعاملة الكنترول (بدون لقاح) في كلا الموسمين – كذلك إضافة السماد العضوي OM والمعدني FM وخليط الاثنين OFM أدى إلى زيادة معنوية لكل من Av - N ، Av - P ، Av - K خلال الموسمين أما في حالة التأثير المشترك لكل من الأسمدة الحيوية والعضوية والسماد المعدني كانت الزيادة أعلى معنوية في كلا موسمي الدراسة حيث كانت أعلى القيم لكل من Av - N هي 63.9 and 64.1 ppm ، Av - P هي 35.75 and 32.5 ppm ، أما Av - K فكانت 98.1 and 101.2 ppm .

- زاد طول النبات – طول السنبلة – عدد حبوب السنبلة – محصول القش - محصول الحبوب والنسبة ونسبة البروتين في الحبوب ووزن ١٠٠٠ حبة بالنسبة لكل السماد العضوي (OM) وخليط السماد العضوي مع السماد المعدني (OFM) ثم السماد المعدني (FM) وكذلك المخصبات الحيوية .

- زاد وزن الحبوب (وزن ١٠٠٠ حبة) زيادة معنوية نتيجة إضافة خليط السماد العضوي والمعدني (OFM) مع المخصب الحيوي الخليط (NPB) .

- نسب الزيادة في محصول الحبوب كانت الأعلى عند إضافة المخصب العضوي (NPB) مع خليط من السماد المعدني في الموسمين الزراعيين ٤٨,٢٨٪ في الموسم الأول – ٥٣,٣٣ ٪ في الموسم الثاني مقارنة مع معاملة الكنترول (بدون لقاح بكتيري – وبدون إضافة أسمدة عضوية ومعدنية .

- كمية الزيادة للبروتين في الحبوب كانت معنوية مع المخصب الحيوي (NPB) وكل من السماد العضوي (OM) وخليط السماد العضوي والمعدني (OFM) [١١,٥٨٪ ، ١١,٤٧ ٪ في السنة الأولى] و [١١,٦٤٪ ، ١١,٣ ٪ في السنة الثانية] .

- إضافة الخليط من السماد العضوي والمعدني مع لقاح بكتيري من السماد الحيوى الخليط (NPB) أعطت أفضل النتائج على كل من مكونات وإنتاج محصول القمح .