COMPARATIVE EFFECTS OF BIO-COMPOST AND COMPOST ON GROWTH, YIELD AND NUTRIENTS CONTENT OF PEA AND WHEAT PLANTS GROWN ON SANDY SOILS.

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Abstract

Two field trials were conducted on a sandy soil at Ismailia Agricultural Research Station to evaluate the response of both pea and wheat plants to the application of Bio-compost (rice straw compost inoculated with some microorganisms, i.e. *Azotobacter chroococcum* ,*Bacillus megatherium* and *Bacillus circulans*), compost I (rice straw compost and inoculation the soil with the same microorganisms) compared with compost II (rice straw compost without inoculation) and mineral fertilizers (NPK).

The agronomic yield components were recorded and the chemical analysis of soil and plants for both pea and wheat at flowering stage (shoots) and harvest stage (straw, seeds or grains), respectively, were done. Total count of three types of bacteria were determined in soil samples at two growth stages as well as dry weight and number of nodules were recorded for pea plants.

Obtained results revealed that application of both Bio-compost and compost I increased the amount of organic matter content, available N (NH_4, NO_3), P (P_2O_5) and K (K_2O) as well as EC and pH values decreased in soil samples at both growth stages of pea and wheat plants. Data also show that compost I treatments were superior in this studied parameters as compared to Bio-compost and compost II.

Nitrogen, phosphorus and potassium uptake along with crude protein in seeds or grains were increased in mineral fertilizer treatments, compost I and Bio-compost as compared to compost II.

On the other hand, data show that application of compost I as a single inoculum had the best results in the number of microorganisms as compared to different treatments in two stages of pea and wheat plants. In addition to that compost I treatment increased the nodulation status of pea plants, but the highest increases in dry weights and number of nodules were recorded when rice straw compost was used and inoculation the soil with *Azotobacter chroococcum*. This may suggest the more suitability of added rice straw compost and inoculation the soil with bacteria as compared to Bio-compost and/or compost II for both pea and wheat plants.

Key word: rice straw compost, biocompost, *Azotobacter chroococcum*, *Bacillus megatherium* and *Bacillus circulans*, pea, wheat, nutrient uptake.

INTRODUCTION

The use of organic fertilization and compost in agriculture are widely practiced in Egypt. Therefore, the technology for recycling farm wastes, particularly wide C/N ratio materials, under intensive cropping system should be developed to increase the crop yield and to maintain soil fertility level. Thus, recycling of crop residues can be performed by incorporating such wastes directly into the soil with concomitant inoculation of microbial decomposers to accelerate their decomposition and to prevent an adverse effect on the plant growth. In this respect, biofertilization with functional groups of microorganisms, mainly biological nitrogen fixers and phosphate, potassium dissolving bacteria are important in soil both through various activities and by the potential to act as nutrient sources (Schnurer and Rosswall, 1987 and Saleh *et al.*, 2000) .

Many bacterial strains including rhizobia bradyrhizobia act as plant growth promoting rhizobacteria (PGPR) and apparently stimulate plant growth mainly by modifying root development which improve macroelements (N, P and K), microelements and water uptake (Antoun, *et al.*, 1998) as well as rhizohium produces enough nitrogen to built up the whole protein requirements of the legumes (Bedrous *et al.* 1990). In addition, organic manure (bio-compost or compost) improves the physical properties of the soil, and increases the supplying power of available nutrients to plants (Ali *et al.*, 2003).

On the other hand, pea and wheat plants were selected as an important test crops for these applications.

However , Negm *et al.* (1998) indicated that pea plants at the vegetative growth stage were affected with rhizobium inoculation and the highest weight was obtained from the chemical N fertilization without inoculation, whereas the lowest was obtained from inoculation plus organic source of N. Voss *et al.* (1987) reported that high rates of mineral N caused low nodule weight but increase pea seeds yield and shoot dry matter when added up to 6o Kg N/ha. In addition to that, Mevat and Dahdoh (1997) indicated that, the inoculation with different bacterial types either singly or in combination led to increase organic matter content in sandy soil.

Khamis and Metwally (1998) showed that the yield of wheat and N uptake were increased by incorporation of organic materials inoculated with microbial decomposers and Azotobacter in the soil, but this increase was not significant.

Kapulnik *et al.* (1985) indicated that inoculation of wheat plants with some bacteria strains alters root morphology, increases numerous plant shoots parameters and eventually increases the yield of many cereal crops.

Resently, Negm *et al.* (2002) found that wheat grain and straw yields significantly increased by application of 1.5 or 3 ton biocompost/fed.

The present study aimed to evaluate the response of both pea and wheat plants to added Bio-compost (rice straw compost inoculated with some microorganisms i.e., *Azotobacter chroococcum, Bacillus megatherium* and *Bacillus circulans*), compost I (rice straw compost and inoculation the soil with the same microorganisms) compared with compost II rice straw compost (without inoculation) and mineral fertilizers (NPK).

MATERIALS AND METHODS

Two field experiments were carried out on sandy soil at Ismailia Agricultural Research Station cultivated with pea (*Pisum sativa,* cv Master), and wheat (*Triticum aestivum* L., cv Gize 168). The physico – chemical properties of the studied soil are presented in Table 1.

Table 1. Some physical and chemical properties of the soil used.

Soil characteristics	Values
Particle size distribution	
Sand	76.68
Fine sand	14.89
Silt	2.09
Clay	6.34
Texture class	Sandy
Saturation percent	24.2
$CaCO_3$	1.60
OM %	0.50
pH (1: 2.5 soil suspension)	7.74
EC_e mmhos/cm	0.37
Cations and anions in sat. Extract (meq / L)	
Calcium	0.97
Magnesium	0.87
Sodium	1.51
Potassium	0.45
Carbonates	-
Bicarbonate	1.42
Chloride	1.02
Sulphate	1.50
Available nutrients (ppm)	
N	85
P	25
K	125
Fe	2.40
Mn	1.50
Zn	0.40
Cu	0.20

Bio-compost of rice straw used in this experiment was inoculated with some bacteria or added rice straw compost to the soil and inoculation the soil with the same microorganisms after sowing pea and wheat. Three different strains of associate N2-Fixing bacteria *(Azotobacter chroococcum)*, phosphate dissolving bacteria (*Bacillus megatherium*)and potassium dissolving bacteria *(Bacillus circulanse)* were provided by the Biofertilizers Unit, Cairo Mircen, Microbiological resource Center. Broth culture of each strain contained Ca. 10^9 cell mL^{-1} was applied as a culture inocula are at the rate of two liter/heap after 150 days from the composting start to enrich the product of compost.The broth culture of the same strain was separately carried on vermiculite based (1:3 V/W) as a local carrier material .The separately or mixed inocula were added at a rate of 300g/fed. according to the following treatments. Chemical analysis of the biocompost and the compost are shown in Table 2.

Table 2. Analyses of experimental materials.

Properties	Compost	Bio-compost		
		A*	B**	C***
EC (1:10)	6.61	3.98	4.52	3.95
pH (1:10)	7.57	7.16	6.83	6.74
OM (%)	56.6	69.47	64.05	63.74
OC (%)	32.9	46.10	37.15	36.97
C/N ratio	14.1	12.13	12.1	12.12
Total macronutrients)				
N (%)	2.33	3.80	3.07	3.05
P (ppm)	5033	5123	5763	5720
K (ppm)	6319	5914	6234	7245
Total micronutrients (ppm)				
Fe	401	4223	4166	3812
Mn	116	1117	1136	1201
Zn	100	121	122	125
Cu	22.7	23	24	30

A* = rice straw pile after addition of *Azotobacter chroococcum*

B** = rice straw pile after addition of *Bacillus megatherium*

C***= rice straw pile after addition of Bacillus circulanse

The experiment included nine treatments as follows:

1- MF Mineral fertilizer (recommended dose).

2- BA rice straw compost enriched with *Azotobacter chroococcum* (Bio – Compost a).

3- BB rice straw compost enriched with *Bacillus megatherium* (Bio – Compost b).

4- BC rice straw compost enriched with *Bacillus circulanse* (Bio- Compost C).

5- BABC rice straw compost enriched with *Azotobacter chroococcum*, *Bacillus megatherium* and *Bacillus circulanse* (Biocompost ABC).

6- CIA rice straw compost and inoculation the soil with *Azotobacter chroococcum* (compost I A)

7- CIB rice straw compost and inoculation the soil with *Bacillus megatherium* (compost I B).

8- CIC rice straw compost and inoculation the soil with *Bacillus circulanse* (compost I C) .

9- CII rice straw compost without any inocula (compost II).

The rice straw Bio- compost and compost in all treatments were added to the soil at rate of 2% organic matter (20 Ton/fed.) by weight .The organic manure was mixed with the soil surface (0-15 cm. Layer), 15 days before cultivation. Pea seeds were planted at November 2002 as well as wheat grains at December 2002. The treatment of mineral fertilizer (control) was achieved according to the recommended dose. This treatment received inorganic fertilizers ammonium sulphate (20% N), phosphate (15% P_2O_5) and potassium sulphate (48% K_2O) at the equivalent rates of 80,60,and 48 Kg /fed. of N, P_2O_5 and K_2O for pea and 100,30 and 48 kg/fed of N, P_2O_5 and K_2O for wheat plants, respectively. Phosphorus and potassium fertilizer were added just before cultivation, while ammonium sulphate was added in four equal doses after 2, 4, 6 and 8 weeks from planting. Each treatment was replicated 3 times in a randomized complete block design. Pea plants were inoculated with gamma irradiated vermiculite-based inoculant of *Rhizobium leguminosarum* bv. viceae at a rate of 200 g/fed. The plant and soil samples were taken at 30 and 120 days after planting of pea as well as 75 and 150 days after planting of wheat which represent flowering and harvesting stages, respectively.

Chemical properties of the used compost and biocompost were measured according to standard methods described by Jodice *et al.* (1982). Total nitrogen and organic carbon were determined according to the standard methods of Page *et al.* (1982). Total contents of phosphorus, potassium and micronutrients were assayed according *to* Black (1982). Plant samples were taken from pea and wheat at two growth stages (flowering and harvesting stages for pea along with booting and harvesting stages for wheat) to represent growth and nutritional status, straw and grain yields were, however, recorded at harvest. Plant samples were dried at 70 C^0 for 48 hrs to be then ground and wet digested using H_2SO_4 : H_2O_2 method described by Black (1982). The digests were then subjected to the measurement of macronutrients (NPK) using procedures described by Cottenie *et al.* (1982). Crude protein content was calculated by multiplying total nitrogen by 6.25.

RESULTS AND DISCUSSION

A: Changes of some chemical properties and nutrients availability of soil Under different treatments.

Data presented in Tables 3 and 4 show the values of pH ,EC, organic matter content and available macronutrients (NH_4 , NO_3 , P and K) in soil treated with Bio-compost, compost I and compost II as compared to mineral fertilizers in soil samples . Results show that pH values, generally, decreased with the application of Bio-compost and compost I or compost II compared to mineral fertilizer at both flowering and harvest stages for pea and wheat plants. Also compost II treatments decreased pH values compared to other treatments. This result may be due to the production of organic acids formed by the bacteria inoculated in the Bio-compost or compost II and inoculation the soil with *Azotobacter chroococcum, Bacillus megatherium* and *Bacillus circulans* (Moharram *et al.,* 1989 and Ali *et al.,* 2003).

With respect to, electric conductivity (EC) values in soil at flowering and after harvest stages of both pea and wheat plants are shown in Tables 3 and 4. Data revealed the decrease of EC values in all Bio-compost and compost treatments as compared to mineral fertilizer. This could be attributed to the forming of dry stable aggregates as a result of added various compost treatments which led to increase salt leaching to the deepest layers of soil and consequently, reduction in the EC values.

Table 3. Effect of Bio-compost and compost treatments on some chemical Properties of soil at two growth stages of pea plants.

Treatments	pH 1:2.5	EC dS/m	Organic Matter %	Available nutrients (ppm)			
				NH_4	NO_3	P_2O_5	K_2O
Flowering stage							
MF	7.75	0.45	0.38	131	12	23.9	132
Bio-compost A	7.42	0.44	0.66	387	91	46.5	291
Bio-compost B	7.43	0.36	0.58	261	67	53.0	272
Bio-compost C	7.51	0.34	0.57	211	61	42.0	301
Bio-compost A,B&C	7.41	0.39	0.60	352	83	58.61	289
Compost IA	7.37	0.40	0.71	410	102	55.7	301
Compost IB	7.35	0.33	0.66	372	91	62.8	298
Compost IC	7.44	0.32	0.69	305	72	47.0	341
Compost II	7.56	0.40	0.53	194	32	39.41	232
L.S.D. 5%	0.81	0.09	0.43	130	11.5	23.6	120
Harvest stage							
MF	7.80	0.42	0.40	98.0	11.0	24.1	182
Bio-compost A	7.41	0.37	0.72	231	81	44.5	301
Bio-compost B	7.46	0.36	0.68	211	61	48.9	298
Bio-compost C	7.47	0.36	0.69	162	92	42.3	346
Bio-compost A,B&C	7.51	0.32	0.73	200	72	44.7	311
Compost IA	7.38	0.41	0.75	312	101	47.8	320
Compost IB	7.37	0.40	0.78	272	98	52.4	401
Compost IC	7.33	0.36	0.62	263	75	43.9	289
Compost II	7.60	0.34	0.58	194	72	41.3	267
L.S.D. 5%	0.66	0.08	0.51	171	58	36.2	191

* MF(Mineral fertilizer) *Bio-compost A (rice straw compost and with *A.chroococcum*)

* Bio-compost B (rice straw compost and with *B. megatherium*)

* Bio-compost C (rice straw compost and with *B. circulanse*)

* Bio-ABC (rice straw compost and with *A. chroococcum* , *B. megatherium* and *B. circulanse*)

* Compost I A(rice straw compost and inoculation the soil with *A. chroococcum*)

* Compost I B (rice straw compost and inoculation the soil with *B. megatherium*)

* Compost I C (rice straw compost and inoculation the soil with *B. circulanse*)

* Compost II (rice straw compost without any inoculation).

Soil organic matter content (OM) varied as a function of the studied variables, Tables 3 and 4. Incorporation of bio-compost, compost I and compost II into the soil caused appreciable accumulation of OM, as compared to mineral fertilizer for both flowering stage and after harvest of pea and wheat plants. Also, compost I (CIA, CIB and CIC) treatments, generally, gave a relatively high values than bio- compost (BA, BB and BC) treatments or compost II. Obtained results could be attributed to inoculation the soil with *Azotobacter chroococcum*, *Bacillus Megatherium* and *Bacillus circulans* presence of compost which enhanced their biological properties and considered as sources for microorganisms and increase total count of bacteria (Dalzell *et al.*1987).

Table 4. Effect of Bio-compost and compost treatments on some chemical Properties of soil at two growth stages of wheat plants.

Treatments	pH 1:2.5	EC dS/m	Organic Matter %	Available nutrients (ppm)			
				NH_4	NO_3	P_2O_5	K_2O
Flowering stage							
MF	7.85	0.47	0.40	176	32	24.3	128
Bio-compost A	7.41	0.36	0.57	251	79	48.6	298
Bio-compost B	7.42	0.38	0.55	220	81	58.7	276
Bio-compost C	7.44	0.35	0.51	211	72	43.7	375
Bio-compost A, B&C	7.46	0.41	0.49	241	63	44.9	278
Compost IA	7.31	0.41	0.58	283	74	55.7	321
Compost IB	7.33	0.40	0.56	231	65	61.8	288
Compost IC	7.38	0.44	0.51	207	52	51.8	389
Compost II	7.46	0.40	0.47	201	49	46.7	243
L.S.D. 5%	0.84	0.07	0.19	198	38	25.8	231
Harvest stage							
MF	7.75	0.38	0.43	156	20	22.0	168
Bio-compost A	7.41	0.34	0.65	237	82	43.9	310
Bio-compost B	7.47	0.31	0.59	216	36	78.6	297
Bio-compost C	7.46	0.30	0.57	197	51	41.3	415
Bio-compost A,B&C	7.48	0.32	0.65	211	76	44.9	290
Compost IA	7.38	0.30	0.67	257	79	47.0	342
Compost IB	7.37	0.33	0.71	220	81	56.2	371
Compost IC	7.39	0.30	0.69	197	32	49.31	422
Compost II	7.54	0.37	0.51	187	33.0	49.3	272
L.S.D. 5%	0.65	0.05	0.18	175	25	18.9	198

* MF (Mineral fertilizer)
*Bio-compost A (rice straw compost and enrich with *A.chroococcum*)
* Bio-compost B (rice straw compost and enrich with *B. megatherium*)
*Bio-compost C (rice straw compost and enrich with *B. circulanse*)

* Bio-ABC (rice straw compost and enrich with *A. chroococcum* , *B. megatherium* and *B. circulanse*)
*Compost I A(rice straw compost and inoculation the soil with *A. chroococcum*)
*Compost I B (rice straw compost and inoculation the soil with *B. megatherium*)
*Compost I C (rice straw compost and inoculation the soil with *B. circulanse*)
* Compost II (rice straw compost without any inoculation).

Macronutrients availability in soil, at flowering stage and after harvest of both pea and wheat plants, are shown in Tables 3 and 4. Data show positive effects by all tested parameters on macronutrients ,nitrogen (NH_4 and NO_3), P (P_2O_5) and K(K_2O), content in soil as compared to mineral fertilizer. Also. Compost I (CIA, CIB & CIC) treatments were superior in all nutrients content as compared to other treatments. On the other hand, inoculation the compost with bacteria (bio-compost) or added compost and inoculation the soil with the same bacteria (compost I) were reflected on the decomposition of compost and the release of the nutrients in soil. These results are in confirmation with results obtained by Ali, *et al.* (2003). Therefore, Single inoculation of compost or soil with *Azotobacter chroococcum*, *Bacillus megatherium* and *Bacillus circulans* caused an increase in nitrogen, posphorus and potassium in soil respectively. Moreover, macronutrients level at flowering stage recorded high values as compared to after harvest of both pea and wheat plants.

In conclusion from the previously results it could be suggested that compost I(rice straw compost and single inoculation the soil with *Azotobacter chroococcum*,*Bacillus megatherium* and *Bacillus circulans* lead to decreasing in pH and EC values along with enhancing either organic matter content or available macronutrients in soil.

B:-Total counts of bacteria which applied in the studied soil:-

The counts of *Azotobacter chroococcum*, *Bacillus megatherium* and *Bacillus circulans* in the studied soil at flowering stage and after harvesting of both pea and wheat plants, are illustrated in Figs. 1 and 2. Obtained Results show that, generally , the count of three different microorganisms were increased in harvest stage as compared to flowering stage in pea and wheat plants. The treatments of rice straw compost and a single inoculation of each strain added to soil (compost I, A, B and C) recorded the highest count of each strain from *Azotobacter chroococcum* ,*Bacillus megatherium* and *Bacillus circulans* as compared to Bio-compost (A, B, C, and ABC) treatments . Also, data revealed that the lowest counts of microorganisms were found in soil samples which treated with mineral fertilizer.

Similar findings were obtained by (Dalzell, *et al.*, 1987) who reported that application of organic waste and compost to soil enhanced their biological properties. They are considered as sources of nutrients and energy for living microorganisms. El-Sersawy *et al.*, (1997) reported that addition of organic materials stimulated total microbial growth particularly in the presence of biofertilization and added that these treatments improved microbial counts of Azotobacter and phosphate dissolving bacteria.

C:- Nodules number and Nodules dry weight of pea plants.

Data presented in Figure 3 indicated that , pea plants inoculated with Rhizobia in compost I (rice straw compost and inoculation the soil with *Azotobacter chroococcum* ,*Bacillus megatherium* and *Bacillus circulans* recorded increases in number and dry weight of nodules compared to unionculated plants or inoculation the compost with the same the microorganisms (bio-compost). Also, inoculation the soil with *A. chroococcum* as a single inoculum with compost recorded the highest increase in inoculum nodule number and dry weight as compared to other treatments .

Similar results were obtained by Abo El – Soud *et al.* (2003) . who reported that inoculation of legumes with *Rhizobium, B. megatherium* and *A chroococum* resulted in the highest number and dry weight of nodules.In addition to that Srinivasan *et al.*,(1996) noticed nodulation enhancement in beans by co -inoculation with *Rhizobum* and *B. megatherium.* They attributed the yield increase to either of infection sites available for rhizobia or production of plant growth promoters by *B. megatherium* .

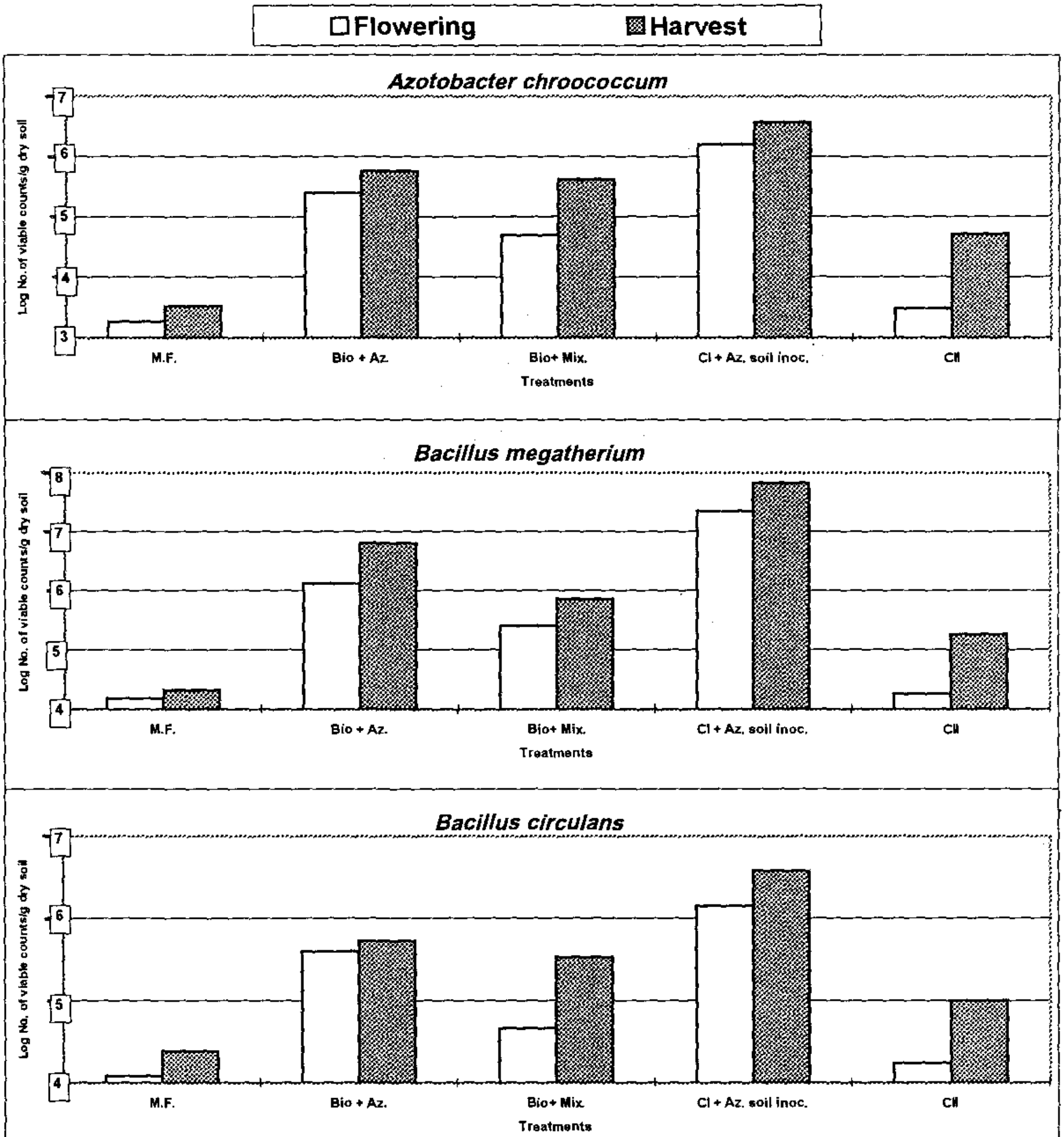

Fig.1. Counts of *Azotobacter chroococcum, Bacillus megatherium* and *Bacillus circulans* of sandy soil at flowering stage and after harvesting of pea plants.

Note : * M.F = Mineral fertilizer

* Bio + Az., Bio + B.m.,Bio + B.c. = Bio-compost enriched with *Azotobacter chroococcum, Bacillus megatherium* or *Bacillus circulans,* respectively, before application to soil.
* CI + mix. = compost enriched with three microorganisms before application to soil.
* CI + Az. soil ino., CI + B.m. soil inoc., CI + B.c. soil inoc.= compost were added to soil, while *Azotobacter chroococcum, Bacillus megatherium* or *Bacillus circulans*, were added as soil inoculation.
* CII = compost (without inoculation).

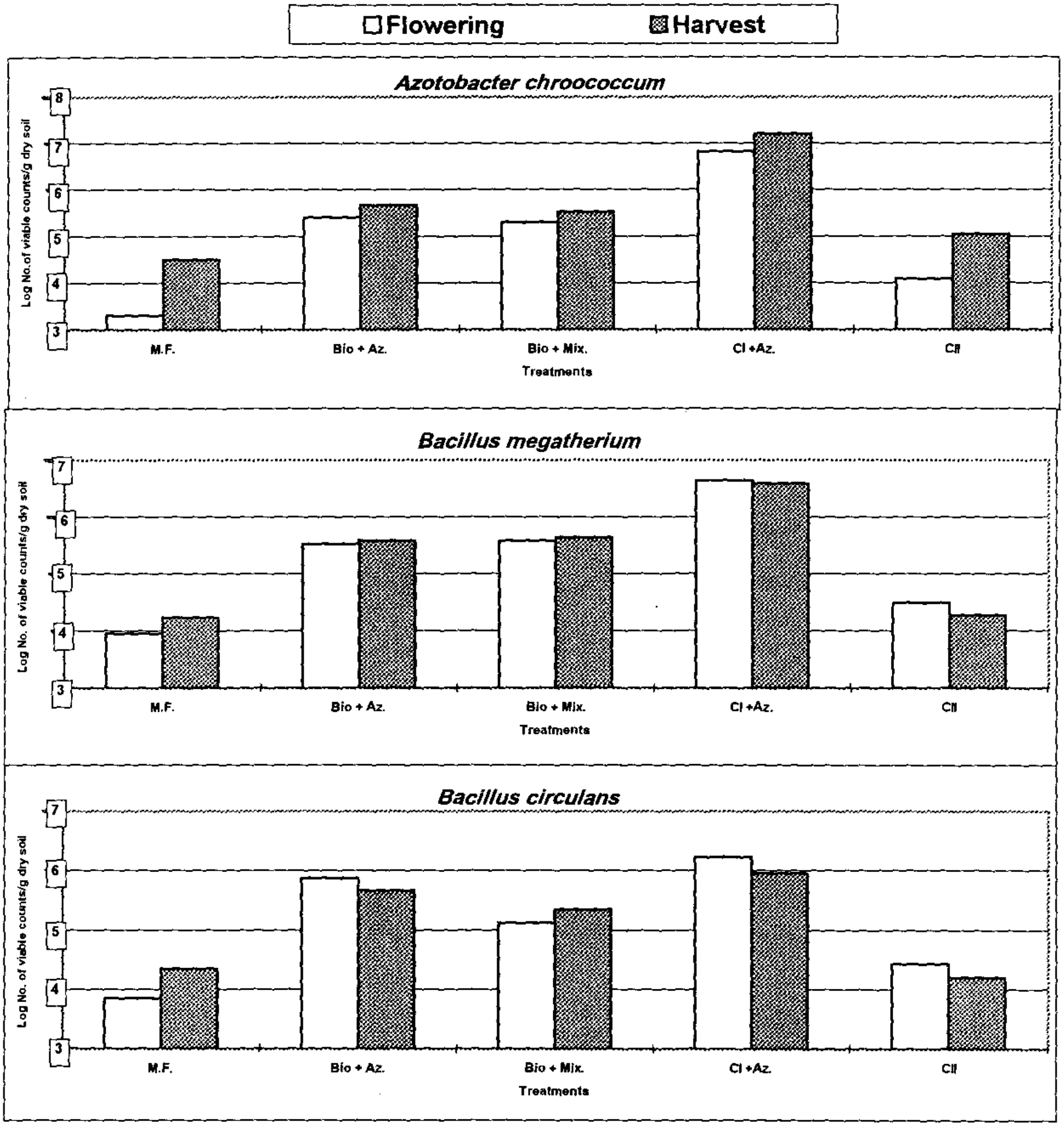

Fig. 2. Counts of *Azotobacter chroococcum, Bacillus megatherium* and *Bacillus circulans* of sandy soil at flowering stage and after harvesting of wheat plants.

Note : * M.F = Mineral fertilizer

* Bio + Az., BIo + B.m., Bio + B.c. = compost enriched with *Azotobacter chroococcum, Bacillus megatherium* or *Bacillus circulans,* respectively, before application to soil.
* Bio + mix. = compost enriched with three microorganisms before application to soil.
* CI + Az. soil inoc., CI + B.m. soil inoc., CI + B.c. soil inoc.= compost I were added to soil, while *Azotobacter chroococcum, Bacillus megatherium* or *Bacillus circulans*, were added as soil inoculation.
* CII = compost II (without inoculation).

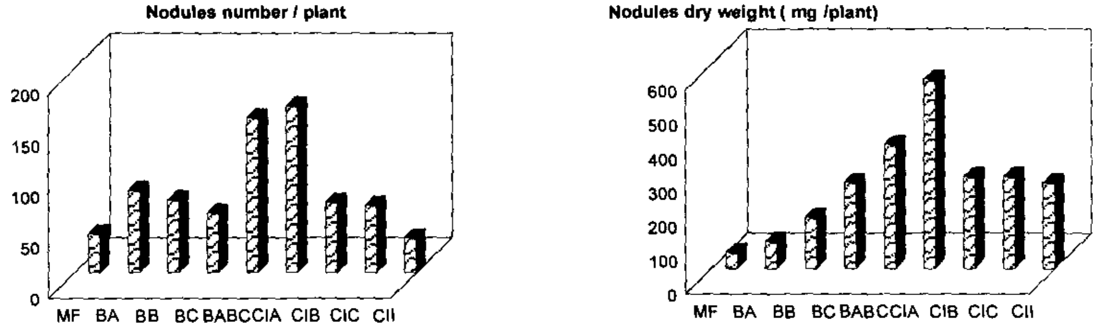

Fig . 3. Effect of bio -compost and compost on nodules number per plant and nodules dry weight (mg/plant) of pea plants .

D- Plant growth as response to the studied parameters .

1-Dry matter production at flowering stage.

Concerning dry matter production of pea and wheat plants, at flowering stage, data in Figure 4 indicated that either bio-compost or compost I treatments improved the dry matter content (g/plant) as compared to compost II. Also, results show that compost IA (rice straw compost and inoculation the soil with *A. chroococcum)* recorded an increase in dry matter contents as compared to other treatments. Moreover, mineral fertilizer treatment was significantly superior in dry matter as compared to all compost treatments, regardless bacteria types, for both pea and wheat plants. Obtained results may be attributed to an increase of plant chlorophyll concentration up to 34 days of growth (Minar and Zehnalek, 1989) along with the effect on the physiological processes namely photosynthetic activity and utilization of carbohydrates (Bethlenfalvay and Pacovsky, 1983).

On the other hand, inoculation treatments with various types of bacteria improved dry matter of both pea and wheat plants as compared to compost II (without any inoculation).This increase in DM of pea plants, recorded 27.3, 23.8, 22.5 and 20.4 % for bio- compost treatments and 41.5, 40.9 and 36.2 % for compost I treatments as well as such increase, of wheat plants, which reach to 7.17, 4.18, 0 and 0.99 % for bio-compost treatments and 10.2, 5.09 and 2.93 % for compost I treatments, respectively.

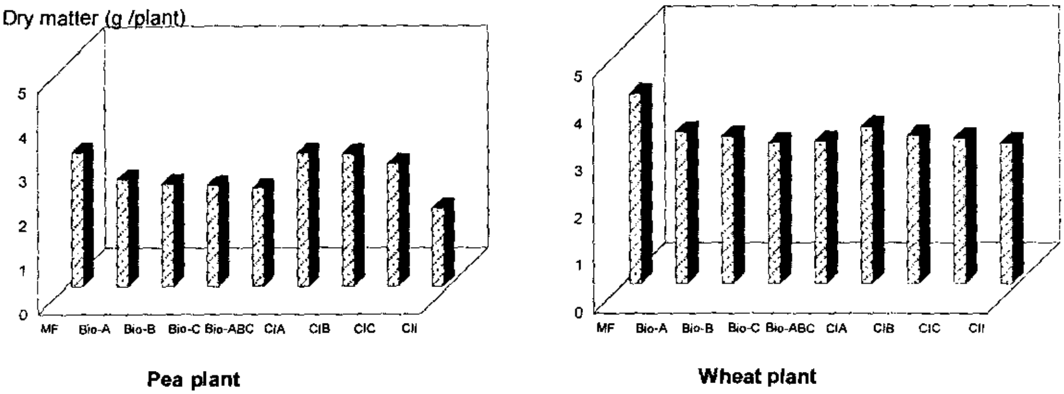

Fig. 4. Effect of bio -compost and compost treatments on dry matter production (g) of both pea and wheat plant at flowering stage

2- Yield and its components:-

Treating the sandy soil with bio-compost, compost I and compost II caused a marked improvement in the yield and its traits, represented by yield of seeds or grains, yield of straw, weight of 1000 seeds or grains and harvest index (Table 5). The magnitude of response varied among various treatments, under study.

Data clearly indicated that the yield and its components tended to increase as a result of mineral fertilizer treatment as compared to other treatments .Also ,incorporation of organic manure as well as compost inoculated with different microorganisms in soil, caused a significant increase in seeds or grains and straw yield compared to compost treatment without inoculation (compost II). Moreover, highest yield was recorded in compost I (ABC), regardless of bacteria type, as compared to bio-compost and compost II treatments. On the other hand, compost I where inoculation with *A .chroococcum* appeared to have maximum increase in seed and straw yield of pea as well as grains and straw yield of wheat as compared to other treatments. Such a result is confirmed by Amara and Dahdoh (1997), Hoflich *et al.* (2000) and Saleh *et al.* (2000).

It may be worth to mention that harvest index and 1000 seeds or grains weight were slightly affected with compost treatments but in case of bio-compost and compost IA such parameters were increased as compared to another bacteria treatments.

E:- Nutrients uptake in pea and wheat plants and crude protein .

Macronutrients uptake were evaluated at two growth stages of pea and wheat plants. Data obtained are recorded in Table 6. Obtained results revealed that, at flowering stage, nutrients uptake (N, P & K) for both pea and wheat plants was affected by compost treatments . Again, mineral fertilizer treatment was superior in (N, P & K) uptake as compared to other bio-compost or compost treatments.

Table 5. Response of pea and wheat yield to applied bio-compost and compost Treatments .

Treatments*	Pea Yield			
	Seeds yield (Kg/ fed.)	Straw yield (Kg/ fed.)	Weight of 1000 seeds (g)	Harvest Index
MF	356	1094	170.1	0.325
Bio-compost A	282	1013	158.3	0.278
Bio-compost B	275	984	149.4	0.279
Bio-compost C	276	954	151.3	0.289
Bio-compost ABC	292	984	161.0	0.297
Compost IA	335	1088	166.2	0.308
Compost IB	324	1054	164.5	0.307
Compost IC	304	1026	163.9	0.296
Compost II	205	850	140.5	0.241
L.S.D. 5%	15.0	33.2	15.0	0.15
	Wheat Yield			
MF	804	927	48.12	0.867
Bio-compost A	740	801	44.06	0.924
Bio-compost B	736	798	43.89	0.922
Bio-compost C	723	786	42.91	0.919
Bio-compost ABC	741	811	43.56	0.914
Compost IA	784	910	47.28	0.862
Compost IB	772	907	47.02	0.851
Compost IC	759	897	45.58	0.846
Compost II	686	741	40.54	0.925
L.S.D. 5%	15	27.4	1.32	0.41

* MF(Mineral fertilizer)
* Bio-compost A (rice straw compost enrich with *A.chroococcum*)
* Bio-compost B (rice straw compost enrich with *B. megatherium*)
* Bio-compost C (rice straw compost and enrich with *B. circulanse*)
* Bio-ABC (rice straw compost enrich with *A. chroococcum* , *B. megatherium* and *B. circulanse*)
* Compost I A(rice straw compost inoculation the soil with *A. chroococcum*)
* Compost I B (rice straw compost and inoculation the soil with *B. megatherium*)
* Compost I C (rice straw compost and inoculation the soil with *B. circulanse*)
* Compost II (rice straw compost without any inoculation).

However, inoculating the soil with *A.chroococcum, B megatherium* and *B. circulanse* and application of compost resulted increase in nutrients ((N, P & K)) uptake as compared to bio-compost or compost II treatments. Single inoculum with *A.chroococcum ,B megatherium* and *B. circulanse* in compost I treatments combined with Rhizobia of pea plants, both of them increased N, P & K uptake . Obtained results were in agreement with the findings of Hussein *et al.* (1997), Parmar and Dadarwal (1999) and Ragab (1998) who reported that inoculation with Rhizobia and Azotobacter or phosphate dissolving bacteria

Table 6 . Macronutrients uptake by pea plant as effected by applied bio-compost and compost treatments

A: - Flowering stages.

Treatments	Pea			Wheat		
	Nutrients uptake (mg/plant)					
	N	P	K	N	P	K
MF	18.21	1.91	8.12	17.01	1.83	17.14
Bio-compost A	13.79	1.11	6.73	10.91	1.53	14.18
Bio-compost B	11.85	1.29	6.03	9.06	1.83	13.59
Bio-compost C	11.20	0.95	7.06	8.42	1.40	16.39
Bio-compost ABC	12.08	1.08	6.43	8.88	1.57	14.98
Compost IA	16.99	1.47	7.06	14.15	1.66	18.75
Compost IB	15.26	1.73	8.82	12.54	1.95	15.45
Compost IC	13.94	1.15	9.04	10.98	1.50	17.53
Compost II	13.14	0.67	4.09	6.42	1.37	14.06
L.S.D. 5%	0.78	0.56	0.87	2.02	0.25	1.25
B: - Seeds or grains yield						
MF	231.81	57.8	236.0	45.23	11.35	16.75
Bio-compost A	166.54	24.82	118.44	39.03	7.57	10.54
Bio-compost B	149.79	28.03	97.61	28.03	7.26	7.68
Bio-compost C	156.75	13.27	172.6	22.26	5.03	9.94
Bio-compost ABC	149.36	17.2	124.1	29.26	5.97	8.44
Compost IA	207.8	41.9	144.1	43.99	9.05	10.82
Compost IB	187.4	44.52	140.2	40.15	10.28	11.94
Compost IC	166.9	23.8	199.5	37.44	7.52	13.73
Compost II	124.51	14.62	97.48	18.92	4.61	5.09
L.S.D. 5%	3.02	1.01	2.52	2.84	1.24	1.51

C:-Straw yield

MF	104.59	16.2	101.9	44.96	17.19	74.24
Bio-compost A	72.66	5.94	64.2	25.28	6.63	42.51
Bio-compost B	64.7	7.24	57.72	17.57	7.28	40.33
Bio-compost C	61.2	4.14	75.7	17.63	5.48	44.17
Bio-compost A,B&C	76.5	4.75	76.4	21.1	7.23	47.82
Compost IA	86.4	8.59	88.5	41.79	10.58	63.50
Compost IB	77.99	11.91	70.11	28.54	12.25	56.08
Compost IC	73.52	13.28	90.9	25.51	9.90	60.92
Compost II	52.74	6.54	51.01	16.51	6.75	37.93
L.S.D. 5%	2.52	0.89	2.03	1.34	0.89	1.06

* MF (Mineral fertilizer)

* Bio-compost A (rice straw compost enrich with *A.chroococcum*)

* Bio-compost B (rice straw compost enrich with *B. megatherium*)

* Bio-compost C (rice straw compost enrich with *B. circulanse*)

* Bio-ABC (rice straw compost enrich with *A. chroococcum* , *B. megatherium* and *B. circulanse*)

* Compost I A(rice straw compost and inoculation the soil with *A. chroococcum*)

* Compost I B (rice straw compost and inoculation the soil with *B. megatherium*)

* Compost I C (rice straw compost and inoculation the soil with *B. circulanse*)

* Compost II (rice straw compost without any inoculation).

Increased P and N content of faba bean plants.

With respect to nutrients status of pea and wheat plants at harvest stage , data presented in Table 6 show that behavior of nitrogen, phosphorus and potassium uptake of the straw and seeds or grains of developed plants followed the same trend of those obtained at flowering stage which had, however, higher values than those obtained at harvest stage. This is true in spite of the superiority of K- uptake in seeds of pea plants treated by bio-compost and compost I treatments. Relatively low values representing the nutrients (N, P & K) status in the straw of the harvest stage may be due to the translocation of the elements to seeds or grains as a step towards their protein synthesis. Obtained data agree with Rashad *et al.* (2001) who reported that such inocula (*A.chroococcum, B megatherium* and *B. circulanse)* may produce growth promoting substances such as auxins, and stimulating the microbial development which is reflected on the nutrient uptake. Also, Farid (2003) added that ,Azorhizobia and many bacteria strains act as plant growth promoting rhizobacteria (PGPR) and improve macronutrients (N , P and K) and water uptake.

It may be worth to mention that nutrient uptake status in seeds or grains of both pea and wheat plants, were positively affected crude protein contents (Figure 5).

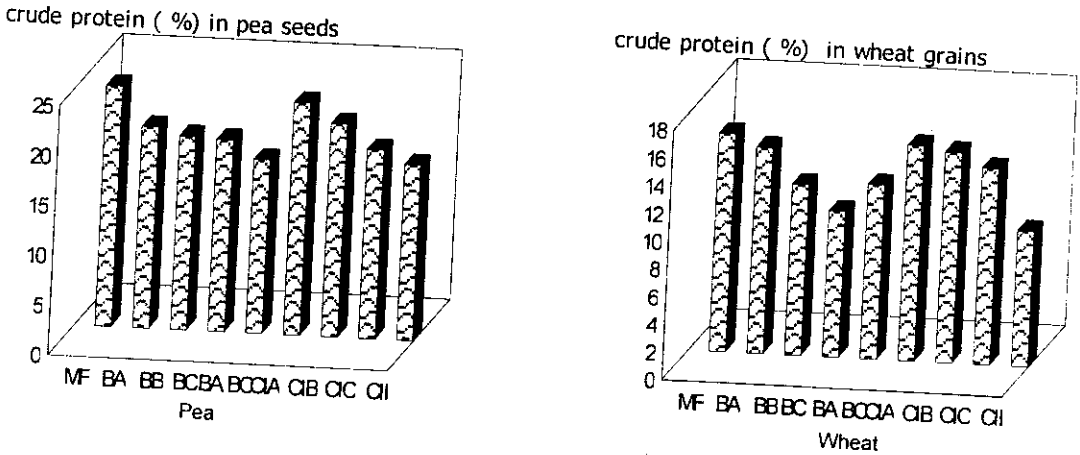

Fig . 5. Effect of bio -compost and compost on crude protein (%) in seeds or grains of both pea and wheat.

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REFERENCES

1. Abo-EL-Soud, A. A., A. A, Ragab. G. A. A. Mekhemar and F. T. M. Khaeel. 2003. Response of faba bean to inoculation with bacteria as influenced by different sources of phosphorus.Egypt. J. Appl.Sci. 18:73-90.
2. Ali. K. M. L., E. T., Wafaa, T. El-Etr and E. I. ElHam. 2003. Evaluation of application of bacterial inocula for rice straw during compost process under aerobic conditions. J. Agric. Sci. Mansoura Univ ., 28:5787-5801.
3. Amara, M. A. T. and M. S. A. Dahdoh. 1997. Effect of inoculation with plant growth promoting rhizobacteria (PGPR) on yield and uptake of nutrients by wheat grown on sandy soils Egypt. J. of Soil Sci., 37:467-484.

4. Antoun, H., C. J. Beauchamp, N. Goussard, R. Chabat and R. Lalande. 1998. Potential of Rhizobium and Bradyrhizobium species as plant growth promoting rhizobacteria on non-legumes, Effect on radishes (Raphanus sativus L.). Plant and Soil,204:57-67.

5. Bedrous, V . S., A. N . EL– Wafai, Y. B. Besada and F. S. Faris. 1990. Studies on the interaction between VA – mycorrhiza , strains of *Rhizobium leguminosarum* biovar. phaseoli and bean cultivars under field condition in Egypt. Zagazig J. Agric. Res . 17:1-11.

6. Bethlenfalvay, G. J. and R. C. Pacovsky. 1983. Light effects on mycorrhiza soybeans. Plant Physiol. 73:969-979.

7. Black, C. A. 1982. Methods of soil analysis. part 2. chemical and microbiological properties. second Edition. Amer. Soc. of Aron. Madison, Wisconsin, U. S. A.

8. Cottenie, A., Verloo, M., Kiekns,L.Velghe, G.and R. Camerlynek. 1982. "Chemical analysis of plants and soils" Lab.Analy.&Agroch.St. State Univ., Ghent,Belgium.

9. Dalzell. H. W., A. G. Bidlestone, K. R. Gray and K. Thurairajan. 1987. Soil management compost production and use in tropical and subtropical environments. FAO, Soil Bulletin, NO. 49.

10. El-Sersawy, M. M., B. F. Abd El-Ghany, K. W. Khalil and S. Y. Awadalla. 1997. Interaction between organic manure mixtures, applied N-level and biofertilization on calcareous soil properties and wheat production in Wadi Sudr,south Sinai Egypt.J. Soil Sci., 37:367-397.

11. Farid S. F. B. 2003. Studies on Bio-organic fertilization of wheat under newly reclaimed soils. Ph. D.Thesis,Fac.of Agric., Cairo univ., Egypt

12. Hoflich G. M., G. K., Tauschke and J. Rogasilk. 2000. Influence of agricultural crops and fertilization on microbial activity and microorganisms in the rhizosphere. J. of Agronomy and Crop Sci. 184:49-64 .

13. Hussein, A. H. A., S. A. Saleh, M. A. El-deeb and W. Kodry. 1997. Effect of Rhizobium inoculation, phosphorus and potassium fertilization on growth, nodulation and yield

of faba bean cultivated in newly reclaimed soils of middle Egypt. Bull. Fac. Agric. Cairo univ., 48:201-214.

14. Jodice, R., A. Luzzati and P. Nappi. 1982. The influence of organic fertilizers, obtained from popular bark, on the correction of iron chlorosis of luipinus albusl. Plant and Soil. 65:309-317.

15. Kapulnik, Y., R. Gafniand and Y. Okon. 1985. Effect of Azospirillum spp. Inoculation on root development and NO_3 uptake in wheat (Triticum aestivum cv Mirian) in hydroponic system. Can. J. Bot.63:627-639.

16. Khamis, M. A., and S. H. M. Metwally. 1998. Utilization of organic materials inoculated with microbial decomposer as a nitrogen source for wheat in presence of Azotobacter in a sandy soil.Egypt.J.Soil Sci.38:81-99.

17. Mervat, A. T., Amara and M. S. A. Dahdoh. 1997. Effect of inoculation with plant growth promoting Rhizobacteria (PGPR) on yield and uptake of nutrients by wheat grown on sandy soils . Egypt J. Soil Sci. 37:467-484.

18. Minar, J. and J . Zehnalek. 1989. The effect of increasing doses of potassium and nitrogen on the growth, chlorophyll cont and accumulation of mineral nutrients in peas (Pisum sativum c v Liliput).Scripta Facutation Scientiarium naturalium Universtitatis puskynianae Brunesis , 19 (1-2),3. CC.F, soils & Fert. 55 (2), 2507).

19. Moharram, T. M., T. H. EL–Dahtory and M. S. A. Safwot. 1989. Microbiological and chemical changes in some local organic waste materials during composting process . Minia J. Agric. and Dev., 11:403-416.

20. Negm M. A, M.H. EL – Sayed , A. S. Ahmed and M.M. Abd Elghani. 2002. Wheat and sorghum response to biocomposit and sulpher added to a calcareous soil. Zagazig J. Agric . Res., 29:1973-1985.

21. Negm, M. A., Kerlous, R.G. and Y. B. Besada. 1998. Different source of nitrogen and Rhizobium Inoculation effect on peas growing on a calcareous soil.Soil Egypt J.Soil Sci. 38:69-75.

22. Page, A. L., R. H. Meller and D. R. Keeneyeds. 1982. "Methods of soil Analysis", parts . chemical and microbiological propertics . Agronomy monograph No.9 ,2nd Ed ., pp. 539- 624.

23. Parmar, N. and K. R. Dadarwal. 1999. Stimulation of nitrogen fixation and induction of flavonoid–like compounds by rhizobacteria. J . of Appl. Microbial.86:36-45.

24. Ragab, A. A. 1998. Integration of microbial inoculation and mineral fertilization for better soybean Environment management. Ph. D Thesis, Fac. Agric. Cairo Univ. Giza Egypt.

25. Rashad, M. H., A.A.Ragab and S. M. Salem 2001. The influence of some *Bradyrhizobium* and *Rhizobium* strains as plant growth promoting rhizobacteria on the growth and yield of sorghum (*sorghum bicolor.* L.*)* plants under drought stress. Plant nutrition – Food Security and sustainability of Agro. 5.

26. Saleh, S. A., D. Swelim and A. A. Ragab. 2000. Response of maize (zea mays) to inoculation with N_2 fixing and phosphate dissolving bacteria in newly reclaimed soils. The tenth conference of microbiology Cairo, Egypt, November 12-14.(pp.119-128).

27. Schnurer, J. and T. Rosswall. 1987. Mineralization of nitrogen from ^{15}N labelled fungi ,soil microbial biomass and roots and its uptake by barley plants. Plant and soil. 102 :71-80.

28. Srinivasan, M., D. J. Petersen, and F. B. Holl. 1996. Influence of IAA producing Bacillus isolates on nodulation of *Phaseoulus vulgaris* by *Rhizobium etli.* Can. J. Microbial. 42:1006-101.

29. Voss, M ., Calegari, A. and P. G. F. Ribeiro 1987. response of peas to inoculation with rhizobium and p fertilizer opplication . Infome de pequisa 73 , 8 (C. F. soils and fert. 53 (4), 5 167).

مقارنة تأثيرالمكمور الحيوى والمكمور على النمو والمحصول والمحتوى من العناصر لكل من نباتات البسلة والقمح النامية فى الاراضى الرملية.

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معهد بحوث الأراضي والمياه- مركز البحوث الزراعية

تــم اجــراء تجربتيــن حقليتيــن فى الاراضى الرملية بمحطة البحوث الزراعية بالاسماعيلية لتقييم استجابة كل من نبات البسلة والقمح لاضافة البيوكمبوست (قش الارز المتخمر والملقح ببعض الكائنات الدقيقة مثل *Azotobacter chroococcum* و *Bacillus Megatherium* و *Bacillus circulans* .
والكمبوســت I (قــش الارز المتخمرمع تلقيح الارض بنفس الكائنات الدقيقة) ومقارنة ذلك بكمبوست II (قش الارزالمتخمربدون تلقيح) والتسميد المعدنى (نيتروجين، فوسفوروبوتاسيوم).

وقــد ســجلت الصفات المحصولية للبسلة والقمح كما اجرى التحليل الكيماوى لكل من الأرض ونبات البســلة والقمــح خــلال مرحلــتى التزهير والحصاد .كما تم اجراء العد البكتيرى للثلاثة انواع من الكائنات المضــافة فــى عيــنات الارض لكــل من المرحلتين وكذلك اجراء الوزن الجاف وعدد العقد الجذرية لنبات البسلة.

ولقــد اشــارت النــتائج الى ان اضافة كل من البيوكمبوست والكمبوست I ادى الى زيادة نسبة المادة العضــوية فــى الارض وكذلــك محتوى الأرض من النتروجين الميسر(نترات وامونيا) والفوسفوروالبوتاسيوم بيــنما انخفــض محتوى الارض من الأملاح الذائبة وكذلك قيم ال pH لكل من المرحلتين والمحصولين تحت الدراسة. كما اظهرت النتائج ايضا تفوق معاملة الكمبوست I فى كل القياسات بالمقارنة بمعاملة البيوكمبوست.

كمــا ادت المعــاملات الــى زيادة امتصاص النتروجين والفوسفور والبوتاسيوم وايضا المحتوى من البروتيــن فــى الحــبوب وذلــك لكل من التسميد المعدنى يليه الكمبوست I ثم البيكمبوست بالمقارنة بمعاملة كمبوست II .

ومــن جهة اخرى اكدت النتائج ان اضافة الكمبوست I اعطت اعلى النتائج للعد البكتيرى بالمقارنة بالمعــاملات الاخــرى فــى كــلا المرحلتين لكل من محصولى البسلة والقمح. بالاضافةالى ذلك ادت اضافة معــاملات الكمبوست I الى زيادة الوزن الجاف و عدد العقد الجذرية لنبات البسلة ولكن كانت افضل زيادة عند اضافة الكمبوست وتلقيح الارض بـــ *Azotobacter chroococcum* .

وممــا ســبق يتبيــن ان اضــافة كمبوست قش الارز وتلقيح الارض بالميكروبات اعطت افضل النــتائج عــند مقارنتها بالكمبوست الحيوى او كمبوست قش الارز بدون أضافة لقاح كسماد عضوى لكل من محصولى البسلة والقمح.