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EFFECT OF BIO-ORGANIC CONDITIONER ON GROWTH AND YIELD OF CORN AND PEANUT CULTIVATED IN SANDY SOIL

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ABSTRACT

Two field experiments were executed in sandy loam soil at El-Tahrir province Sector during the summer growing season of 2004 to evaluate the effect of a natural soil amendment enriched with some mineral amendments and biofertilizers on growth, yield and some nutrient status of corn and peanut crops under sprinkler irrigation system. Four bio-organic conditioner levels (zero, 2.5, 5.0 and 7.5 tons fed^{-1}) were used in both field experiments as compared the use of 10 tons fed^{-1} FYM, as a traditional organic fertilizer. Half dose of N-fertilization (60 kg N fed^{-1}) was added to corn plants in combination with different levels of organic materials, except for the recommended treatment (which received 120 kg N fed^{-1} + 5.0 tons fed^{-1} FYM). Seeds of peanut were inoculated with *Bradyrhizobium* spp. (*Arachis*) as a nitrogen fixing bacteria in combination with different levels of organic materials, except for the recommended treatment that received a starter dose of N (20 kg N fed^{-1}).

Corn field experiment results showed that addition of bio-organic conditioner (at rates of 5.0 or 7.5 tons fed^{-1}) in combination with half dose of N-fertilizer exhibited significant increases in all vegetative growth parameters. Data concerning the corn yield as well as their crude protein and micronutrients concentration reconfirmed the stimulative effect of such combined treatments.

Results of peanut experiment showed that application of bio-organic conditioner (5.0 or 7.5 tons fed^{-1}) along with *Bradyrhizobium* inoculation led to a substantial increases in number and dry weight of nodular tissues, dry weight of shoots and roots as well as total-N content and micronutrients concentration. Also, data concerning the peanut yield as well as crude protein and micronutrients concentration confirmed again the positive effect of such combination.

It is worthy to note that the bio-organic conditioner product not only acts as a soil amendment but also acts as bio-organic fertilizers and plant growth promoting Rhizobacteria. This means that this product may enhance the growth, yield and its chemical composition either in legumes or non-legumes under sandy soil conditions.

Keywords:Sandy soil, Bio-organic conditioner, Plant growth promoting Rhizobacteria, Bradyrhizobium spp., Corn and peanut yields.

INTRODUCTION

The increase in population in Egypt requires putting a new land under cultivation such as sandy and calcareous soils. They are characterized by a rapid turnover of organic materials. Therefore, the application of organic fertilizers seems to be of great value for improving their biological, chemical and physical properties.

In Egypt, the use of organic materials as fertilizers and soil amendments began to decline while the use of mineral fertilizers is increasing. At the moment, crop residues are utilized largely for burning, industry and animal feed. Cattle dung is used as fuel. The amounts of farmyard manure, which is available to the Egyptian farmer are not sufficient and it is very poor in organic matter and plant nutrient contents. Hence, the disintegration of the organic fertilizers in soil is very important in order to achieve the important roles of its activity. It adds organic matter, which improves soil structure, aggregate formation, drought protection, stopping erosion buffering, reduces fertilizer requirements and gave nutrients when plants need them as well as inoculates the soil with vast numbers of beneficial microbes. Thus, compost can modify soil physical properties and strongly affects its chemical and biological ones (Abdel-Malek *et al.*, 1961; Martin & Gershuny, 1992 ; Mekail, 1998 and. Fontaine *et al.*, 2003). On the other hand, enrichment of compost by different materials is often justified in order to improve chemical composition and physical structure of the product, to supply desirable microorganisms and to reduce nitrogen losses. In this concern, Gaur (1986), Martin & Gershuny (1992), Abdel-Wahab (1999) and Badawi (2003) reported that there are two ways in which an activator may influence a compost heap: (1) by addition of some strains of microorganisms to enhance breaking down of organic matter and (2) by increasing the nitrogen and other nutrients content of heap.

Hence, organic materials and biofertilizers became the alternative solution for reducing the chemical fertilizers and saving environment. In the meantime, addition of organic fertilizers in sandy soil improves soil structure. This structural improvement helps the plant to have a good root development by improving soil aeration, which leads to high yield. However, nitrogen chemical fertilizers can readily made available to plants but subjected to various losses through volatilization, leaching and the denitrification processes (Gaur, 1986; Ismail, 1996; Shabayek, 1997 and Badran *et al.*, 2000).

Over the last few years, a diverse array of bacterial species including *Pseudomonas, Serratia, Azospirillum, Azotobacter, Bacillus, Klebsiella* and *Anterobacter* has been shown to promote plant growth. The mechanism by which these rhizobacteria enhance plant growth is not clear, but it is postulated that they may: (a) production of secondary metabolites such as antibiotics, cyanide and hormonelike substances, (b) production of siderophores, (c) dinitrogen fixation (d) increase phosphate solubilization, (e) enhance mineral uptake and/or (f) antagonism to soil borne root pathogens (Okon & Kapulnik, 1986; Dileep Kumar *et al.*, 2001 and Nelson, 2004). On the other hand, *Rhizobium* and *Bradyrhizobium* are also widely used in agriculture for crop improvement because of their ability to induce plants to fix atmospheric nitrogen. Logically, potentials for improving plant yield by combining these plant growth promoting organisms with co-inoculation and rhizobia have also been a subject of several investigators (Dashti *et al.*, 1998 and Dileep kumar *et al.*, 2001). In this respect, Zhang *et al.*, (1996), El-Sawi *et al.* (2001) and Bai *et al.* (2002) found that co-inoculation of legumes with Rhizobia and plant growth promoting rhizobacteria (PGPR) (such as *Pseudomonas*, *Bacillus* and *Serratia* strains) led to positive effects on nodulation, growth and yield of legume crops.

Use of compost as an amendment can significantly influence the incidence of the PGPR benefit plants. El-Sersawy *et al.*, (1997) and Khamis & Metwally (1998) studied the utilization of organic materials inoculated with microbial decomposers and *Azotobacter* under sandy soil conditions. They found that the addition of organic materials to soil stimulated total microbial growth particularly in the presence of biofertilization. These treatments show corresponding improvements in microbial counts, *Azotobacter*, *Azospirilla* and phosphate dissolving bacteria.

The current work is an attempt to shed light on the response of corn and peanut plants to different levels of an enriched bio-organic conditioner combined with half dose of the recommended nitrogen and compared to the full recommended nitrogen dose. As well as the nitrogen content and micronutrients content for both corn and peanut yield components were also cosidered in sandy soil under sprinkler irrigation system.

MATERIALS AND METHODS

Two field experiments were carried out at El-Tahrir Province Sector in the West Delta during the summer season of May 2004 to study the effect of different levels of non-traditional bio-organic conditioner on growth and yield as well as their nutrients content of corn and peanut plants under sandy soil conditions.

Soil Sampling:

Representative soil samples were collected from the top 20 cm layer of the experimental fields, sieved through 2 mm screen and air-dried. The main physical, chemical and biological properties of the soil are shown in Table (1).

Bio-organic conditioner:

Bio-organic conditioner used in this study was done by treating the mixture of peanut shell and saw dust residues (at a ratio of 1:1 w/w) with 5% sulfuric acid solution and maintained at 50% moisture content at room temperature for 7 days. Then, this mixture was autoclaved at 1.5 atmospheric pressure for 2 hr. The mixture received rock-phosphate and manganese-ore dust at rate of 10 and 5%, respectively, from the original mixture weight. They thoroughly mixed and well tamped, and then left for 15 days with maintaining the moisture content at 50%. Afterwards, the mixture is treated with 20% bentonite and 5% urea and inoculated with *Trichoderma* sp., then they composted for 30 days. After elapsing of composting period., the product was bore with some beneficial microorganisms (namely *Azotobacter, Azospirillum, Bacillus, Pseudomonas* and *Serratia*) and left 10 days as a final step for production the bio-organic conditioner compound (Abdel-Wahab and Ahmed, 2003). The product was submitted to different chemical and biological examination (Table, 1).

Farmyard Manure (FYM) :

Farmyard manure used in this investigation collected from El-Tahrir Province. The chemical and biological properties of manure are given in Table (1).

Microbial strains:

All microorganisms used in preparing the bio-organic conditioner as well as *Bradyrhizobium* spp. (*Arachis*) as a mixture of two strains ARC601 and ARC 6011 used in peanut inoculation were kindly supplied by Biofertilizers Production Unit, Soils, Water and Environ. Res. Inst., ARC, Giza, Egypt.

Table (1): Characteristics of soil, farmyard manure and the bio-organic conditioner used in both field experiments

Property	Soil	Farmyard manure	Bio-organic conditioner
Sand (%)	68.96	-	-
Silt (%)	24.80	-	-
Clay (%)	6.24	-	-
Texture grade	Sandy loam	-	-
S.P (%)	41	-	-
pH	7.3	8.96	6.47
E.C. (dSm^{-1} at 25°C)	0.37	4.89	7.19
Soluble cations and anions (meq/L)			
Ca^{++}	1.85	-	-
Mg^{++}	0.97	-	-
Na^{+}	0.81	-	-
K^{+}	0.28	-	-
$CO_3^{=}$	--	-	-
HCO_3^{-}	0.81	-	-
Cl^{-}	0.79	-	-
$SO_4^{=}$	2.31	-	-
Organic-C (%)	0.36	12.71	26.77
Total N (%)	0.031	0.83	1.31
C/N ratio	11.61	15.31	20.44
Total-P (%)	-	0.56	1.16
Total-K (%)	-	1.51	0.64
Total soluble-N (ppm)	31.0	86.0	862.1
Available-P (ppm)	7.3	14.3	296.0
Available-K (ppm)	-	861.0	913.0
DTPA extractable (ppm):			
Fe	3.5	158.4	624.8
Mn	3.1	36.6	63.9
Zn	1.2	28.4	39.5
Cu	0.3	2.43	8.2
Total count of bacteria	6.9×10^5	4.0×10^7	14×10^7
Total count of fungi	0.9×10^4	7.3×10^6	13×10^6
Total count of actinomycetes	1.1×10^4	3.1×10^6	2.7×10^6
Dehydrogenase activity (µg TPF/g)	5.4	218.0	142.5

Plant cultivars:

Corn seeds (*Zea mays*, cv. Hybrid 10) and peanut seeds (*Arachis hypogaea,* var. Giza 5) were kindly provided by Field Crops Research Institute, Agricultural Res. Center (ARC), Giza, Egypt.

Field experiments:

Two factorial field experiments (complete randomized block design) with three replicates were done. The plot area was 10.5 m^2 (3 x 3.5 **m**) and each plot consisted of four rows. Bio-organic conditioner (at the rates of zero, 2.5, 5.0 and 7.5 ton fed^{-1}) and farmyard manure were added, to both field experiments, 15 days before cultivation and ploughed in the soil.

Corn and peanut seeds were cultivated as recommended practices for each crop in such employed soil. Seeds were sown in hills 20 cm apart with 2 seeds per hill. Irrigation was done using sprinkler system according to each plant requirement. Culture of *Bradyrhizobium* spp. (approximately 10^9 cells ml^{-1}) was added to solid carrier (vermiculite + peat) to prepare the inoculant used for peanut inoculation. Seed inoculation was done at sowing using Arabic gum solution as adhesive agent. Inoculant was applied at rate of 600 g 50 kg^{-1} peanut seeds.

Superphosphate (15.5% P_2O_5) and potassium sulfate (48% K_2O) were incorporated into soil before sowing at a rates of 200 and 50 kg fed^{-1}, respectively. After germination of corn plants, all plots were fertilized with ammonium sulfate (20.5% N) at rate of 60 kg N fed^{-1}, while the recommended treatment received 120 kg N fed^{-1}. The following treatments were studied:

Corn experiment	Peanut experiment
Treatments	
Control	Control
2.5 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	Inoculation with *Bradyrhizobium spp.* + 20 kg N fed^{-1}
5.0 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	*Bradyrhizobium spp.*+2.5 tons fed^{-1} bio-organic conditioner
7.5 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	*Bradyrhizobium spp.*+5.0 tons fed^{-1} bio-organic conditioner
10 tons fed^{-1} farmyard manure (FYM)+ 60 kg N fed^{-1}	*Bradyrhizobium spp.*+7.5 tons fed^{-1} bio-organic conditioner
Full dose of N fertilizer (120 kg N fed^{-1}) + 5.0 tons fed^{-1} FYM	*Bradyrhizobium spp.*+10 tons fed^{-1} farmyard manure

Corn and peanut plants were harvested after 60 and 120 days from cultivation to evaluate the vegetative growth, yield and yield components as well as their contents of nitrogen, iron, manganese and zinc.

Analyses:

Soil: Mechanical and chemical analyses of experimental soil before planting was carried out according to Black *et al.*, (1965). While, Biological properties of soil were determined according to Page *et al.*, (1982).

Organic materials: All chemical and microbiological characteristics of the bio-organic conditioner and FYM were executed according to Page *et al.*, (1982).

Plant materials: The oven dried plant materials were wet digested by using mixture from pure $HClO_4$ and H_2SO_4 at ratio 1:1 according to Jackson (1973). The chemical analyses (N, Fe, Mn and Zn concentrations) of plant materials were conducted according to Page *et al.*, (1982).

Statistical analysis: Data were subjected to analysis of variance (ANOVA) according to the procedure of Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

I. Corn experiment:

(a) Vegetative growth :

Data on vegetative growth of 60 day-old corn plants as affected by different levels of organic fertilization are presented in Table (2). Investigated parameters includes dry weight, total N-content and micronutrients concentration of both shoots and roots. Results showed that the application of organic fertilization treatments induced significant increases in all vegetative parameters under investigation.

Concerning to plant dry weight, data showed that addition of full dose of N-fertilizer (120 kg N fed^{-1}) or any level of organic materials plus 60 kg N fed^{-1} led to significant increase in plant dry matter as compared to the absolute control. Using the recommended treatment gave higher values of plant dry matter (14.67 and 47.99 g plant^{-1} for root and shoot, respectively) than using any level of bio-organic conditioner, but the values didn't reach to the level of significance. This flourished growth due to bio-organic conditioner application is expected and reflects the prominent role of organic matter in establishment of suitable growth media for corn plants via improving the physical, chemical and biological properties of sandy soil. Claims to the promotion effect of using bio-organic fertilization especially when accompanied with half dose of mineral N fertilizer on vegetative growth were reported by various workers (Sakr *et al.*, 1992 ; Moharram *et al.*, 1997 ; Abdel-Wahab, 1999 and Badawi *et al.*, 2003).

Regarding to total N-content, data of Table (2) demonstrated that the response of corn plants to nitrogen accumulation as affected by different levels of organic materials followed a similar pattern to that of corn dry weight. Using the recommended treatment as well as 5.0 or 7.5 ton fed^{-1} bio-organic conditioner plus 60 kg N fed^{-1} in sandy soil were more suitable to accumulate higher amounts of N in corn tissues, and this effect is more clear in shoot tissues. The relative increases over the absolute control were 962.20, 657.01 and 861.42% in roots and 907.79, 845.89 and 893.22% in shoots, respectively. These results may due to the suitable soil conditioner C/N ratio which has a great effect on the quickness and easiness of the decomposition and activity of the soil available nitrogen and accordingly the nitrogen content in plant. Also, such increases in the N-content mainly attributed to the increases in both root and shoot dry weights as well as the increases in the percentages of N. These results stand in accordance with those of Sakr *et al.* (1992), Moharram *et al.* (1997). Abdel-Wahab (1999) and Badawi (2003) who found that N-uptake by wheat and maize crops increased by addition of enriched compost materials in combination with 50-60 kg N fed^{-1} in calcareous and sandy soils.

With respect to micronutrients concentration in corn tissues, results in Table (2) confirmed again the superiority of using the bio-organic conditioner plus half dose of N-fertilizer in increasing the concentrations of Fe, Mn and Zn in relative to the absolute control. The higher values of iron and manganese (787.3 and 91.5 ppm) of roots and (694.5 and 60.0 ppm) of shoots were obtained by using 7.5 ton fed^{-1} bio-organic conditioner plus 60 kg N/fed. While, using of 5.0 ton fed^{-1} plus 60 kg N fed^{-1} achieved higher values of Zn in roots and shoots to be 132.8 ppm and 85.3 ppm, respectively. This favorable effect could be due to the action of organic acids produced during decomposition and forming soluble chelates that help in mobilizing these nutrients and increasing their availability for plant uptake. These results are coincided with those obtained by Bar-Ness & Chen (1991) and Mekail (1998) who mentioned that composted materials considered the major source of both available phosphorus and micronutrients when soil humus is presented in appropriate amounts.

(b) Yield:

Effect of organic fertilization on corn yield and their nutrient status under sandy soil conditions are presented in Table (3). Obtained results showed significant responses, in most parameters due to organic fertilization.

The response of corn yield to organic fertilization showed higher increases in both stalk or grain yield as affected by any level or type of organic fertilization. For instance, the addition of bio-organic conditioner at levels 2.5, 5.0 or 7.5 ton fed^{-1} in combination with 60 kg N fed^{-1} led to increase the grain yield of corn by 263.56%, 273.10% and 297.56%, respectively, over the untreated treatment. The increases on stalk yield were 162.26%, 169.18% and 173.58%, respectively over the absolute control in the same order. Also, data indicated that the grain yield gradually increased with increasing applied rate of bio-organic conditioner or using the recommended treatment, and the differences didn't reach to the level of significance. The direct effect of bio-organic conditioner in increasing corn yield could be explained through its favorable role in soil water retention and maintenance of applied nutrients against losses, which, in turn, enhanced translocation efficiency of assimilates to corn. These results support those obtained by Sikora and Azad (1993), El-Awag *et al.* (1996), Khamis and Metwally (1998), Badran (2002) and Badawi (2003).

With respect to crude protein in corn tissues, Table (3) showed that the application of any level of bio-organic conditioner or 10 ton fed^{-1} FYM with 60 kg N fed^{-1} increased significantly crude protein percent to be similar or higher than those obtained by using the recommended treatment. This trend is true in both grain and stalks.

Table (2): Effect of different levels of organic fertilization on growth and nutrient status of corn plants after 60 days of planting

Treatments	Dry weight (g plant^{-1})		N-content (mg plant^{-1})		Micronutrient concentration in root (ppm)			Micronutrient concentration in shoot (ppm)		
	root	shoot	root	shoot	Fe	Mn	Zn	Fe	Mn	Zn
Control	2.02	7.82	12.70	69.30	408.5	47.8	66.0	429.5	38.5	49.5
2.5 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	10.29	47.55	77.20	630.20	722.3	83.8	121.0	676.5	58.3	84.8
5.0 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	11.92	47.90	96.14	655.50	770.8	85.0	132.8	680.5	54.3	85.3
7.5 tons fed^{-1} bio-organic conditioner + 60 kg kg N fed^{-1}	12.23	47.60	122.10	688.30	787.3	91.5	107.3	694.5	60.0	85.8
10 tons fed^{-1} farmyard manure (FYM)+60 kg N fed^{-1}	12.68	45.19	97.30	614.90	761.8	88.5	123.0	677.5	51.8	79.3
Full dose of N fertilizer (120 kg N fed^{-1}) + 5.0 tons fed^{-1} FYM	14.67	47.99	134.90	698.40	691.5	74.3	128.3	631.0	55.3	77.3
LSD at 0.05	1.914	5.518	20.11	185.70	124.00	12.98	23.31	99.40	12.37	13.14

Table (3): Effect of different levels of organic fertilization on corn yield, crude protein content and nutrient status

Treatments	Stalk yield	Grain yield	Crude protein (%)		Micronutrient concentration in stalk (ppm)			Micronutrient concentration in grain (ppm)		
	(tons fed^{-1})	(kg fed^{-1})	stalk	grain	Fe	Mn	Zn	Fe	Mn	Zn
Control	1.59	397.4	3.94	7.85	357.8	38.8	54.0	176.3	20.0	30.5
2.5 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	4.17	1444.8	5.02	10.74	638.8	57.5	60.5	237.3	27.4	53.8
5.0 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	4.28	1482.7	4.55	11.40	667.8	63.8	66.3	287.5	30.0	57.5
7.5 tons fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}	4.35	1579.9	5.75	12.21	656.3	73.5	82.5	367.5	33.0	53.8
10 tons fed^{-1} farmyard manure (FYM)+60 kg N fed^{-1}	4.50	1569.6	5.85	11.67	605.0	76.0	78.8	350.0	30.3	57.3
Full dose of N fertilizer (120 kg N fed^{-1}) + 5.0 tons fed^{-1} FYM	4.55	1589.5	5.76	11.91	542.5	66.5	72.3	294.8	28.8	49.0
LSD. at 0.05	0.221	149.18	0.958	1.203	122.30	13.57	N.S	117.70	N.S	15.23

However, application of 7.5 ton fed^{-1} bio-organic conditioner plus 60 kg N fed^{-1} gave relatively higher percentages of crude protein, particularly in grain which recorded 12.21%. The magnitude of percentage increases in the stalk protein were 45.94, 48.48 and 46.19 above the absolute control for 7.5 ton fed^{-1} bio-organic conditioner + 60 kg N fed^{-1}, 10 tons fed^{-1} FYM + 60 kg N fed^{-1} and the recommended treatments, respectively. The corresponding percentages recorded in grain crude protein were 55.54, 48.66 and 51.72, respectively over the absolute control.

Enhancing of protein content in corn plants due to organic bio-conditioner may be explained by the existence of Rhizobacteria as a vital portion in this bio-conditioner which possess several mode of actions to promote plant growth and nutrient uptake, particularly offering of nitrogen to plants. These results were consistent with those obtained by Ishac *et al.*, (1986), Rai and Gaur (1988), Srinivasan *et al.* (1997) and Saubidet *et al* (2002) who reported that the combination of either symbiotic or associative nitrogen fixers with cellulose decomposers or *Bacillus megaterium* improved the root proliferation, nutrients availability and enhanced the activity of nitrogen fixers in rhizosphere. Dobbelaere *et al.* (2003) and Kennedy *et al.* (2004) added that a large number of different diazotrophic as well as non-diazotrophic species may contribute to the beneficial effects on the growth, nutrients uptake and yield of cereals.

The results of micronutrients concentration in both stalk and grain (Table 3), followed the general trend associated with the micronutrients concentration obtained in the 60 day-old corn sample. Although there were no significant differences between different levels and types of organic materials, but using higher rates of bio-organic conditioner (5.0 or 7.5 ton fed^{-1}) exhibited higher values of micronutrients in corn stalk and grains. Such effect might be related to the better nutritional status of the plants upon organic materials application that reduced soil pH which increased the nutrient availability to the plant. Also, presence of natural organic chelating compounds released from composted materials could be the reason. These results agreed mostly with those obtained by El-Gala *et al.*, (1990), Zaid & Kareim (1992) and Abdel-Wahab (1999).

II. Peanut experiment:

(a) Vegetative growth:

Results of field-grown peanut after 60 days of planting as affected by *Bradyrhizobium* inoculation combined with different levels of organic materials are given in Table (4). Obtained data showed that all vegetative growth parameters were significantly affected by different treatments under study.

Table (4) shows the combined effect of organic fertilization and *Bradyrhizobium* inoculation on the nodulation status of peanut root. Irrespective of level of organic materials, the nodular tissues exhibited significant increases due to its application as compared to unamended control. Significant increases of nodules number and dry weight for seed coating with *Bradyrhizobium* inoculation combined with bio-organic conditioner (2.5, 5.0 or 7.5 ton fed^{-1}) nearly similar to or higher than values obtained by using the recommended treatment. In fact, the addition of enriched organic materials to sandy soil led to raise its fertility, which, reflected by enhancing the root proliferation and nodule formation. Also, such results indicate that several PGPR exert significant effects on *Rhizobium*-legume symbiosis. Such promotion of nodulation pattern in many legumes are confirmed by many investigators (Zhang *et al.*, 1996 ; Dashti *et al.*, 1998, El-Sawi *et al.*, 2001, Bai *et al.*, 2002, Abdel-Wahab *et al.*, 2003 and Abdel-Wahab & Said, 2004).

Concerning to dry weight of 60 day-old peanut plants, data in Table (4) illustrated that addition of organic materials led to a higher increases in both roots and shoots dry weight to be similar or higher than values obtained by using the recommended treatment. This positive effect was magnified when combined with *Bradyrhizobium* inoculation particularly at high level of bio-organic conditioner (5 or 7.5 ton fed^{-1}), which gave the highest values of plant dry matter. Using such treatments exhibited increases in roots dry weight over the absolute control to be 98.91% and 100.0%, respectively. While increases in shoots dry weight were 78.50% and 72.62%, respectively. The increase in dry matter may be attributed in part to the effect of organic material used on the production of humus substances which improve the physical, chemical properties of soil as well as increasing the water holding capacity and increment in the availability of nutrients of the soil which leading to establish suitable growth media for growing plants. Claims to the promotion effect of enriched bio-organic conditioner on plant growth were reported by various workers, Bashan and Levanony (1990), Antoun *et al* (1998), Abdel-Wahab (1999) and Abdel-Wahab *et al.* (2003) who explained the favorable effects of the combination between compost and biofertilizers on the basis of the beneficial effects of bacteria on the nutrients availability, vital enzymes, hormonal stimulating effects on plant growth or the increasing of photosynthetic activity.

With regard to N-content and micronutrients concentration, data presented in Table (4) showed the total-N content in both roots and shoots are in parallel with dry matter results. This could be due to the presence of applied amendments (enriched with some beneficial microorganisms as PGPR, which may improve the performance of symbiotic nitrogen fixation by peanut plants in the sandy soil and accordingly the nitrogen content. These results are in conformity with those of (Lawson *et al.*, 1995 ; Moharram *et al.*, 1998 ; Abdel-Wahab, 1999 and Bai *et al.*, 2002). Also, the concentration of micronutrients in both roots and shoots of peanut mostly exhibited the same trend noticed for total N-content. These results could be explained by the degradation of organic materials which enhance the levels of reachable micronutrients complexes and other organic complexed compounds such as organic acids and polysaccharides. In this concern, El-Gala & Amberger (1982) and Bar-Ness and Chen (1991) reported that fulvic acids, organic acids and amino acids were among the active organic components that were found to play a role in binding Fe, Mn, Zn and Cu and act in transporting of such micronutrients in soil.

(b) Yield :

Table (5) shows the effect of organic fertilization on yield as well as protein and micronutrients concentration of peanut grown under sandy soil conditions. Data of all tested parameters responded significantly to the tested bio-organic treatments except the crude protein of seeds, to different treatments under study.

Data of peanut yield indicated that inoculated plants simultaneously supplied with higher rates of bio-organic conditioner (5 or 7.5 tons fed^{-1}) recorded significant increases in pods and straw yield as compared with unamended treatments. The increase in pod yield by using the recommended treatments of 5.0 tons fed^{-1} or 7.5 tons fed^{-1} bio-organic conditioner with inoculation were 21.35%, 33.97% and 32.03% over the absolute control, respectively. The obtained data strongly emphasized the superiority of such bio-organic conditioner enriched with promoting Rhizobacteria along with rhizobial inoculation in enhancement the peanut yield. The beneficial effect of such organic amendment incorporated into soil on peanut yield may due to the regulation of soil temperature, conservation of moisture and improvement in humic content of the soil, which, are important factors in increasing the number of microflora and activity and hence greater nutrient availability. The promotive effect of enriched compost with *Bradyrhizobium* inoculation on yield productivity was demonstrated by many investigators in newly reclaimed soils (Mekail, 1998; Abdel-Wahab, 1999; El-Sawi *et al.*, 2001 and Abdel-Wahab & Said, 2004).

Regarding to crude protein content, Table (5) showed that, although the response in seeds was insignificant, the higher values of seed crude protein was obtained by using the bio-organic conditioner (5.0 or 7.5 tons fed^{-1}) in the presence of *Bradyrhizobium* inoculation. The same trend was obtained in straw crude protein, but the response was significant. The increases in seed crude protein, over the absolute control, by using 5 and 7.5 tons bio-organic conditioner/fed were 12.97% and 19.03%, respectively. While, the increases in straw were 18.72% and 18.72%, respectively. This could due to the presence of applied amendments which may enhance the activity of nitrogen fixers in the rhizosphere by growth promoting substances and nutrients in available forms. These results are in agreement with those obtained by Ishac *et al.* (1986), Rai & Gaur (1988), Srinivasan *et al.* (1997) and Abdel-Wahab (1999). Recently, Abo El-Soud *et al.* (2004) reported that *Bradyrhizobium* inoculation alone or in combination with *Bacillus pumilus* and/or *Serratia marcescens* increased the nodulation status, nitrogen content as well as pods, straw and protein yields of peanut plants grown under field conditions.

Concerning to micronutrients concentration, data given in Table (5) showed that, irrespective of *Bradyrhizobium* inoculation, the addition of any level of bio-organic conditioner (2.5, 5.0 or 7.5 tons fed^{-1}) or using 10 tons fed^{-1} FYM increased significantly the concentration of Fe, Mn and Zn contents of seeds and straw as compared to recommended and control treatments. The higher values of Fe in seeds (361.50 and 375.3 ppm) were obtained by using 5 and 7.5 tons fed^{-1} bio-organic conditioner, respectively. While, the higher values of Fe in straw (688.5 and 705.5 ppm) were attained by using 2.5 and 5.0 tons fed^{-1}, respectively.

Table (4): Effect of different levels of organic fertilization on nodulation, grwoth and nutrient uptake of peanut plants after 60 days of planting

Treatments	Nodules/ plant		Dry weight (g/plant)		N-content (mg/plant)		Micronutrient concentration in root (ppm)			Micronutrient concentration in shoot (ppm)		
	No.	D.Wt. (mg)	root	shoot	root	shoot	Fe	Mn	Zn	Fe	Mn	Zn
Control	126.5	221.0	0.92	28.23	11.2	599.7	473.8	58.5	87.3	418.0	50.3	62.0
Inoculation with *Bradyrhizobium* spp. + 20 kg N fed^{-1}	219.0	495.3	1.69	48.05	22.9	1440.3	596.5	63.8	94.3	425.5	54.5	69.0
Bradyrhizobium spp.+2.5 tons fed^{-1} bio-organic conditioner	192.0	472.9	1.69	48.41	23.5	1494.0	772.3	105.3	120.3	622.0	79.3	93.8
Bradyrhizobium spp.+5.0 tons fed^{-1} bio-organic conditioner	166.3	503.5	1.83	50.39	29.6	1535.5	781.0	99.0	122.3	673.0	81.8	97.8
Bradyrhizobium spp.+7.5 tons fed^{-1} bio-organic conditioner	150.0	522.5	1.84	48.73	26.4	1503.8	826.3	115.3	137.5	766.8	104.8	116.3
Bradyrhizobium spp.+10 tons fed^{-1} farmyard manure	192.5	351.4	1.85	48.17	27.9	1476.8	801.0	105.8	127.3	725.3	98.8	115.0
LSD. at 0.05	**44.48**	**53.22**	**0.205**	**5.376**	**4.73**	**281.30**	**58.15**	**14.94**	**15.04**	**111.90**	**11.54**	**12.51**

Table (5): Effect of different levels organic fertilization on peanut yield, protein content and nutrient concentration

Treatments	Yield (kg/fed)		Protein content (%)		Micronutrient concentration in seeds (ppm)			Micronutrient concentration in straw (ppm)		
	pod	straw	seed	straw	Fe	Mn	Zn	Fe	Mn	Zn
Control	1234.1	1096.3	22.75	9.35	195.8	29.0	33.5	392.3	47.0	56.0
Inoculation with *Bradyrhizobium* spp. + 20 kg N fed^{-1}	1497.6	1192.3	24.58	10.56	197.8	31.5	35.8	390.5	45.0	54.5
Bradyrhizobium spp.+2.5 tons fed^{-1} bio-organic conditioner	1576.6	1276.0	25.60	9.83	314.5	46.5	45.5	688.5	67.8	81.5
Bradyrhizobium spp.+5.0 tons fed^{-1} bio-organic conditioner	1653.3	1354.5	25.70	11.10	361.5	47.3	51.0	705.5	78.5	87.8
Bradyrhizobium spp.+7.5 tons fed^{-1} bio-organic conditioner	1629.4	1505.8	27.08	11.10	375.3	51.3	57.0	626.5	82.5	87.0
Bradyrhizobium spp.+10 tons fed^{-1} farmyard manure	1611.3	1461.8	25.63	10.95	363.5	47.8	54.5	596.5	73.5	78.5
LSD at 0.05	**123.40**	**216.80**	**N.S**	**1.156**	**36.11**	**9.17**	**9.70**	**51.08**	**10.62**	**10.35**

On the other hand, the application of 7.5 tons fed^{-1} followed by 5.0 tons fed^{-1} bio-organic conditioner exhibited the higher values of Mn and Zn in both seeds and straw. The results confirmed again the role of such decomposable organic materials in increasing the availability of micronutrients. This could due to the beneficial effect of organic materials and Rhizobacteria which acts as a chelating compounds that can protect these micronutrients against the precipitation factors in soil and becomes more available to plants and general mobility in soils. These results are in accordance with those obtained by El-Gala & Amberger (1982), El-Gala *et al.* (1990), Bar-Ness & Chen (1991), Zaid & Kriem (1992) and Abdel-Wahab (1999).

From the abovementioned results, it could be concluded that the addition of bio-organic conditioner to sandy soil not only acts as a soil amendment but also behave likewise as bio-organic fertilizers and plant growth promoting Rhizobacteria. This means that this product may enhancing the growth, yield and its chemical composition either in legumes (peanut) or non-legumes (corn). This study therefore, suggested that the use of a combination of 5.0 ton bio-organic conditioner along with 50% N (for corn cultivation) and *Bradyrhizobium* inoculation (for peanut cultivation) resulted in sustaining corn and peanut yield under sandy soil conditions. More confirmation studies are needed to establish this bio-organic phenomenon as soil conditioner in the newly soils such as sandy soil.

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تاثير المحسن الحيوي العضوي على النمو ومحصول الذرة والفول السوداني الناميين في الأراضي الرملية

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أجريت تجربتين حقليتين في أرض رملية بقطاع جنوب التحرير خلال الموسم الصيفي لدراسة تاثير إضافة محسن تربة طبيعي والمضاف له بعض المحسنات المعدنية والمخصب بإضافة بعض الميكروبات المفيدة على صفات النمو والمحصول وكذلك على المحتوى من النيتروجين والعناصر الصغرى لكل من نباتات الذرة والفول السوداني تحت نظام الري بالرش. تم اختبار ٤ مستويات من المحسن الحيوي العضوي (صفر ، ٢,٥ ، ٥,٠ و ٧,٥ طن/فدان) وكذلك استخدام مصدر سماد عضوي تقليدي (١٠ طن/فدان سماد بلدي) في كلا التجربتين وتم إضافتهم للتربة قبل الزراعة بـــ١٥ يوم. تم إضافة ٦٠ كجم ن/فدان وهى نصف الجرعة الموصى بها لزراعة الذرة متداخلة مع هذه المستويات من الأسمدة العضوية مقارنة بالمعاملة الموصى بها (١٢٠ كجم ن/فدان + ٥ طن سماد بلدي/فدان). وفى التجربة الأخرى تم تلقيح تقاوي السوداني عند الزراعة بالبراد ريزوبيم في وجود المستويات المختلفة من المحسن العضوي والسماد البلدي سابقة الذكر في غياب التسميد النيتروجينى المعدني وذلك مقارنة بالمعاملة الموصى بها لزراعة السوداني (٢٠ كجم ن/فدان + التلقيح البرادى ريزوبيم). كان أهم النتائج المتحصل عليها ما يلي:-

أشارت نتائج تجربة الذرة إلى أن استخدام المعدلات المرتفعة من المحسن الحيوي العضوي (٥ أو ٧,٥ طن/فدان) في وجود ٦٠ كجم ن/فدان أدى إلى زيادة معنوية في كل الصفات الخضرية المدروسة (الوزن الجاف للجذور والمجموع الخضري و المحتوى من النيتروجين وتركيز العناصر الصغرى في كل من الجذور والمجموع الخضري). كما أكدت النتائج الخاصة بمحصول الذرة (حطب وحبوب) وتركيز كل من البروتين الخام والعناصر الصغرى إلى أفضلية استخدام هذا المحسن العضوي في وجود نصف المعدل من التسميد النيتروجيني المعدني.

أشارت نتائج المرحلة الخضرية لنباتات الفول السوداني إلى أن استخدام المعدل العالي من المحسن العضوي الحيوي (٥ أو ٧,٥ طن/فدان) في وجود التلقيح بالبرادي ريزوبيم إلى زيادة معنوية في العدد والوزن الجاف للعقد البكتيرية والوزن الجاف للمجموع الجذري والخضري وكذلك المحتوى الكلى من النيتروجين وتركيز العناصر الصغرى في كل من الجذور والمجموع الخضري. أيضا أكدت نتائج محصول السوداني وتركيز البروتين والعناصر الصغرى في كل من البذور والقش إلى أفضلية استخدام هذا المعدل العالي من المحسن بجانب التلقيح البرادى ريزوبيم.

ويتضح من النتائج السابقة أن دور هذا المحسن لا ينحصر فقط كمحسن لخواص التربة الرملية ولكنه يعمل أيضا كسماد حيوي عضوي وكمصدر للإمداد بالبكتيريا المفرزة للمواد المنشطة للنمو. لذلك يتضح أن استخدام مثل هذه النوعية من المحسنات ربما تحسن النمو والمحصول والمحتوى الكيماوى لكل من البقوليات (مثل الفول السوداني) وغير البقوليات (مثل الذرة) في الأراضي الرملية.