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EFFECT OF DIFFERENT TYPES AND LEVELS OF ORGANIC FERTILIZERS COMBINED WITH BIOFERTILIZER ON GROWTH AND YIELD OF TOMATO GROWN IN SANDY SOIL

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ABSTRACT

A field trail was carried out in sandy soil at Borollous location North Nile Delta, Kafr EL-Sheikh Governorate during two successive summer seasons of 2003 and 2004. The study concerned with the effect of different types and levels of organic manures combined with inoculation of tomato plants with Mycorrhiza and Azospirillum as biofertilizers on plant growth, yield and its components as well as fruit quality. Besides, the microbiological activity in rhizosphere area of tomato root in terms of Mycorrhiza root colonization, the cell counts of Azospirillum and nitrogenous activity were also studied. Results revealed that the highest vegetative growth i.e. stem length, number of branches and leaves as well as fresh and dry weight of tomato plant were obtained by applying 10 ton/fed. of chicken manure + biofertilizers. On the contrary the lowest values were recorded with the other compost treatments included in this study i.e. Obour, Biogreen and EL-Arish with biofertilizer.

Regarding plant chemical constituents, i.e. NPK, chlorophyll as well as fruit chemical contents, i.e. acidity, Vitamin C and TSS, results showed that the leaf content of chlorophyll as well as N, P, were higher by using chicken manure combined with bio fertilizer than the other studied types of compost. The concentration of vitamin C in tomato fruit increased significantly by using chicken manure combined with Bio-fertilizers. Tomato plants fertilized with chicken manure at a rate of 8 ton /fed. combined with biofertilizer produced the highest fruit yield as compared with the other tested treatments in this study. Concerning root rhizosphere tomato microbial activity, results revealed that all tested treatments increased significantly all microbial tested parameters over the control in both seasons. However, using chicken manure + biofertilizers gave the highest percentage of root Mycorrhiza colonization, as well as cell counts of Azospirillum and nitrogenase activity compared to the other tested organic manures + biofertilizer including control treatment. It can be recommended that chicken manure at a rate of 8 ton /fed + biofertilizer, which gave the highest fruit yield with best quality as well as microbial activity for the root rhizosphere, can be used for tomato cultivation in sandy soil. Moreover, producing tomato crop free from any chemical residues, through avoiding the use of chemical fertilizers.

INTRODUCTION

Egyptian agriculture was organic by nature before 1940. More than 1,300,000 feddan of land maintained its organic nature until the high Dam was constructed in 1965. Recently, most Egyptian agriculture has been industrialized, with intensive use of agrochemicals. Consequently, many negative environmental impacts and harmful health effects of contaminated agricultural products have been documented. Epidemic effect on Egyptian farmers and citizens from agrochemicals are an increasingly serious threat. Pollution of Nile as a direct result of intensive agrochemical use causes a real

health hazard for all Egyptian citizens. Consumers recognize the farmers' achievements and increasingly demand organic food. They accept paying a premium price for organic products, which is fair, because the costs to minimize negative side effect of farming are calculated in loud prices.

Tomato "*Lycopersicon esculentum* Mill." is one of the most important vegetables in Egypt for fresh consumption and processing. For high production the plants require high levels of NPK at different growth stages. The amounts of nitrogen available to plants in different soil types are usually small. It can add nitrogen fertilizer from many sources such as mineral fertilizer, organic fertilizers, bio-fertilizers or mixture of them.

Adding the recommended nitrogen fertilizer to tomato plants induce high improvement either in growth and / or yield beside its components.

Recently, several investigators reported that, it is possible to obtain the same results of chemical fertilizers on tomato plants by using different kinds of organic manure combined with bio-fertilizers and minimize the pollution effect of mineral fertilizer either on the environment and/or consumers. Warman (1990) showed that chicken manure increased total yield on tomato. Saber and Gomaa (1993) found that inoculation of tomato seeds with phosphate dissolving bacteria increased growth and yield on tomato compared with untreated treatment. Hesieh and Hsu (1994) declared that plant height as well as fruit size and fruit number of pepper were significantly higher with the application of organic manure than those with chemical fertilizer. Gomaa (1995) reported that adding chicken manure at a rate of $20m^3$/fed in the presence nitrogen fixing bacteria induced the highest values of chlorophyll and chlorophyll a + b in tomato leaves grown in sandy soil. Adding bio-fertilizer to tomato plants increased vegetative growth characters (Terry *et. al.* 1996). Bambel *et al.* (1998), Abd EL-Fattah and Sorial (2000) noticed that using the *Azospirillum lipoferum* as biofertilizer after sowing squash seeds induced positive effects.

EL-Sheikh and Salama (1997) mentioned that application of chicken manure at rates of 30 and 45 kg / 540 m^2 enhanced the growth of tomato plant (plant height, leaf number and fruit number) as well as increased early and total yield, fruit components and their properties. The highest concentration of TSS was recorded by application of chicken manure + Nitrogen fixing Bacteria. Application of organic fertilizers increased total yield of tomato (Ouda, 2000). Xu, *et al.* (2000) observed that the application of organic fertilizers increased leaf concentration of sugars but nitrate level was lower as compared with the addition of chemical fertilizer.

Azospirillum inoculation increased total yield and average fruit weight of tomato (Abdel. Fattah and Sorial, 2000; Shehata, *et al.*, 2001 and Darwesh, 2002). Several investigators found that, organic fertilizer increased vegetative growth characters of tomato plants, i.e. plant height, number of leaves and branches and leaf area (Abdallah *et al.*, 2001; Darwesh, 2002 and Salam 2002;). Salam (2002) recorded that, the physical proprieties of tomato fruits, i..e. fruit length, diameter and size and chemical contents (ascorbic acid, total acidity and total soluble solids) were increased with adding either organic fertilizer or biofertilizer. Darwesh, (2002) stated that adding organic manure increased fruit contents of total sugars.

Abou-Hussein *et al.* (2003) found that cattle manure at a rate of 30m^3/fed combined with chicken manure at a rate of 10m^3/fed. Increased vegetative growth, i.e., plant height, leaves and stem fresh weight, N, P and K% and total yield of potato tubers compared with the chemical treatment (control). Single inoculation of tomato and cucumber plants with *Azotobacter* caused an increase in nitrogen content by 75 and 50 % in cucumber and tomato plants compared with uninoculated plants, respectively.

Abou EL-Kasem (2006) found that fertilizing tomato plants grown in sandy soil with chicken manure + pressed olive cake with inoculation by Nitrogen fixing bactaria was the fovarable treatment for increasing growth parameters as well as total yield and its components followed by the treatment received chicken manure + Nitrogen fixing bacteria only while application of chicken manure with phosphate dissolving bacteria recorded the highest values of total acidity and vitamin C.

Abou EL-Kasem (2006) claimed also that application of organic manure sources, i.e. chicken manure or pressed olive cake in the presence of biofertilizers had no significant effect on fruit N content. While phosphorus fruit content showed significant values by using the treatment of chicken manure + Pressed olive cake in the presence of Nitrogen fixing bacteria. Adding to that, potassium fruit content increased significantly by using the same organic fertilizers but in the presence of phosphate dissolving bacteria. Abou EL-Kasem, (2006) added also that, tomato leaf content of phosphorus as well as potassium increased significantly by application of chicken manure combined with biofertilizers, while. N leaf content did not show any increment.

The aim of this study was to investigate the use of different sources of compost and chicken manure with bio-fertilizer (*Azospirillum* + Mycorrhiza) on growth and yield of tomato grown in sandy newly reclaimed soil compared with application of chemical fertilizers only. This study included also testing the microbiological activity in tomato rhizosphere area to reach the best treatments for the safe production of tomato.

MATERIALS AND METHODS

A field trail was executed during early summer season of 2003 and 2004 in sandy soil at Borollous location, north Nile Delta Kafr EL-Sheikh governorate, to study the effect of different sources and levels of organic manures with inoculation of bio-fertilizer, i.e., Mycorrhiza and *Azospirillum* on plant growth, yield and its components, tomato fruit quality as well as the microbiological activity in root tomato rhizosphere area in terms of Mycorrhiza root colonization, the cell counts of *Azospirillum* and nitrogenase activity.

Tomato hybrid cv. Peto pride was used. Seeds were sown in seedling trays under plastic house in the nursery on 5th of January and the seedlings were transplanted on 25th of February in both seasons with spacing of 50cm between the plants. The experiment included 17 treatments as follows:

1- 6 ton chicken manure / fed combined with bio–fertilizer.
2- 8 ton chicken manure / fed combined with bio–fertilizer.
3- 10 ton chicken manure / fed combined with bio–fertilizer.
4- 6 ton Bio-green compost / fed combined with bio–fertilizer.

5- 8 ton Bio-green compost / fed combined with bio–fertilizer.
6- 10 ton Bio-green compost / fed combined with bio–fertilizer.
7- 6 ton EL-Obour compost / fed combined with bio–fertilizer.
8- 8 ton EL-Obour compost / fed combined with bio–fertilizer.
9- 10 ton EL-Obour compost / fed combined with bio–fertilizer.
10- 6 ton EL-Arish compost / fed combined with bio–fertilizer.
11- 8 ton EL-Arish compost / fed combined with bio–fertilizer..
12- 10 ton EL-Arish compost / fed combined with bio–fertilizer.
13- 6 ton chicken manure / fed without bio–fertilizer.
14- 6 ton Bio-green compost / fed without bio–fertilizer.
15- 6 ton EL-Obour compost / fed without bio–fertilizer.
16- 6 ton EL-Arish compost / fed without bio–fertilizer.
17-Control (without organic or Biofertilizer but adding the recommended dose of NP & K).

Both chicken manure and compost were added during soil preparation with 100 kg of mineral sulphur per feddan for every treatment. Bio-fertilizer, *Azospirillum* was added three times. The first dose was applied by inocu'ating the seeds just before sowing in the nursery, the second was added to the seedlings before transplanting and the third was added 45 days after transplanting. While, for Mycorrhiza, the seed were inoculated just before sowing. Drip irrigation system was installed with laterals over ridges. Drip irrigation laterals were spaced at 1.5m with 0.5m apart between nozzles. Normal cultivation practices were followed according to the recommendation of the Ministry of Agriculture. The previous treatments were arranged in four replicates using complete randomized block design. Each replicate contained 17 treatments distributed at random in 17 plots. The area of each plot was $33m^2$ contained 44 plants. Physical and chemical properties of the experimented soil are presented in Table (1). The analyses of Chicken manure, Bio-green compost, EL-Obour compost and EL-Arish compost used are shown in Table (2).

Inoculation procedure:

For *Azospirillum* inoculation, seeds for inoculated plots were soaked for 30 minutes in a well homogenized broth culture of *A. lipoferum* containing 10^8 cell ml^{-1}. Arabic gum was used as an adhesive agent. For VAM *Mycorrhiza*, seeds were inoculated by using 500g inoculum from the mycorrhizal spores prepared as described by Difco (1985). In un-inoculated plots seeds were similarly treated with either the control medium free from *Azospirillum* or with a liquid inoculum filtrate free from *Mycorrhiza* spores.

Table (1) Chemical and physical analyses of the experimental soil at Borollous.

pH	Ec	$CaCo_3$	N	P	Cations meq			Anions meq			Mechanical Analysis			
	DS/m	%	Ppm)(		K^+	Ca^{++}	Mg^{++}	Hco_3^-	Cl^-	So_4^-	Sand %	Silt %	Clay %	Texture
8.20	1.5	4.50	Traces	0.46	1.52	2.55	1.30	1.87	2.10	1.40	88	5	7	Sandy

Table (2) Some chemical characteristics of the studied compost.

	Macro nutrients (%)			Humidy	O M	$CaCo_3$	C/N	EC	pH
	N	P	K	%	%	%	Ratio	mmhos/ cm	
Chicken manure	1.49	1.84	1.12	18.1	36.2	3.81	1:14	4.22	8.21
Bio-green compost	1.42	1.73	0.93	14.6	24.2	2.73	1:15	1.53	8.73
EL-Obour compost	1.38	1.66	0.90	16.2	29.2	3.52	1:11	3.51	8.16
EL-Arish compost	1.25	1.61	0.81	12.6	21.3	3.32	1:17	3.81	9.25

The following data were collected:

1 Vegetative growth:

Random samples of ten plants from each treatment were collected 60 days after transplanting (at the flowering stage) and the following data were recorded.

1- Plant height (cm).
2- Leaf number / plant.
3- Number of branches / plant.
4- stem diameter (cm).
5- Leaf area (cm^2) of the sixth leaf from the meristemic tip of the main stem was determined using LI –3000 portable Area Meter (PAM).
6- Fresh plant weight (gm)
7- Dry plant weight was determined after drying the plant samples at 70°C until constant weight.

2- Yield and its components.

1- Total yield (kg / plant) and (Ton/fed.).
2- Fruit characteristics: ten fruits from each replicate were taken randomly for determining average fruit characters as follows:
   A- Average fruit length (cm.)
   B- Average fruit diameter (cm.)
   C- Average fruit weight (gm.)
   D- Total Soluble Solids (TSS)%

3- Chemical constituents:

A- Total nitrogen, Phosphorus and potassium were determined in the dry matter of leaves and fruits according to the methods described by Pregl (1945); Trough and Mayer (1939) and Brown and Lilliland (1946) respectively.

b- Vitamin C content in the fruits.

Ascorbic acid was determined by titration with 2, 6 diclorophenol indophenol blue dye according to the method reported in A.O.A.C. (1975).

c- Acidity in the fruit:

The acidity in fruit juice was assayed as citric acid by the titration with 0.1 sodium hydroxide after adding a few drops of phenolphthaline as an indicator (A.O.A. C. 1975).

d- Total soluble solids:

The total soluble solids were determined in fruit juice using a zeiss hand refractometer.

4- Rhizosphere microbial activity:

At harvest, the root rhizosphere area for tomato plants was exposed to determine total cell number of *Azospirilium* (Dobereiner, *et al.*, 1976). Nitrogenase activity (N-ase) was estimated in Tomato root rhizosphere are as noted by Lethbridge *et al.* (1982). Root Mycorrhiza colonization percentage was determined after staining the root samples using the gridline intersect method (Giovannetti and Mosse, 1980).

All obtained data were statistically analyzed for variance and the mean values were compared at 5% level of LSD according to (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

1- Vegetative growth of tomato:

Table (3) shows the effect of different sources and levels of organic manure combined with or without bio fertilizer on vegetative growth of tomato plants cultivated in sandy soil at Borollous area. Data showed that the highest plant length was obtained by fertilizing tomato plants with chicken manure + biofertilizer. The difference was significant between the mentioned and all other compost types. The lowest length was obtained by using Obour compost, Arish compost and Biogreen compost without bio-fertilizer. These results might be attributed to the high contents of chicken manure from NPK and organic matter than the other compost types as shown in Table (2).

Concerning the effect of compost types on vegetative growth results showed that the Biogreen compost + bio fertilizer was more effective than Obour or Arish compost. These results were true during the both cultivated seasons (2003 and 2004).

The highest values for number of branches and leaves were obtained by applying 10 ton /fed of chicken manure + bio fertilizer with significant difference between this treatment and any other treatment used in this experiment. The lowest values were obtained from the Obour compost and Biogreen without biofertilizer. Fresh and dry weights of tomato plant increased significantly by fertilizing tomato plants with 10 ton/fed. of chicken manure + Biofertilizer. The lowest values were obtained by applying Obour compost and Arish compost respectively. These results were true during both studied seasons. As for stem diameter no significant differences were noticed between all fertilizer treatments and control. Therefore, it can be concluded that chicken manure + biofertilizer gave the highest values of vegetative growth parameters compared with Obour, Arish, Biogreen compost and the control. Biogreen compost + biofertilizer showed the best vegetative growth compared with Obour and Arish compost + bio fertilizer.

The obtained data are in agreement with those reported by Abu Hussein *et al.* (2003) who found that cattle manure at a rat of 30 m^3 + 10m^3 chicken manure increased the vegetative growth traits, i.e. plant height, leaf number and fresh weight. Data also are in harmony with those of Saber and Gomaa (1993) and Hesieh and Hsu (1994) on tomato and pepper, respectively.

Table (3) Effect of some organic manure combined with biofertilizers on the vegetative growth and dry matter of tomato plants grown in summer seasons of 2003 and 2004.

Season / Treatments	First season of 2003						Second season of 2004					
	Plant height	Stem diameter (cm)	No. of branches	No. of leaves	F. W. (gm)	D. W. (gm)	Plant height	Stem diameter (cm)	No. of branches	No. of leaves	F. W. (gm)	D. W. (gm)
1-6 ton/fed. Chicken manure + bio	70.3	1.9	13.0	113.7	435.9	84.07	69.2	1.7	12.4	104.5	429.1	87.68
2-8 ton/fed. Chicken manure + bio	79.2	2.2	13.0	114.0	491.1	94.71	75.5	1.9	14.6	111.0	468.2	95.34
3-10 ton/fed. Chicken manure + bio	82.7	2.2	16.0	119.4	517.8	98.89	77.3	2.3	15.2	117.5	479.4	97.62
4- 6 ton/fed. Bio-green compost + bio	61.3	1.6	9.3	64.0	380.1	72.74	63.4	1.7	8.5	67.0	393.1	80.06
5- 8 ton/fed. Bio-green compost + bio	61.7	1.6	11.7	78.0	382.6	77.92	63.5	1.8	9.5	73.4	393.8	80.20
6-10 ton/fed. Bio-green compost + bio	63.4	1.8	12.0	92.7	393.1	75.23	65.3	1.9	9.7	89.0	405.0	82.48
7- 6 ton/fed. Obour compost + bio	45.0	1.5	6.7	58.3	280.5	57.13	46.6	1.6	7.5	62.0	281.3	57.25
8- 8 ton/fed. Obour compost + bio	50.3	1.6	8.7	64.0	301.6	62.11	48.8	1.6	9.0	63.3	294.5	59.96
9-10 ton/fed. Obour compost + bio	58.3	1.9	8.8	74.0	349.6	52.18	52.6	1.6	9.1	77.0	330.2	67.25
10- 6 ton/fed. EL-Arish compost + bio	55.3	1.6	8.0	55.7	342.9	65.62	56.2	1.6	7.7	67.3	348.5	70.97
11- 8 ton/fed. EL-Arish compost + bio	58.4	1.6	11.0	69.0	362.1	69.29	58.6	1.7	8.2	73.0	363.4	74.00
12-10 ton/fed. EL-Arish compost + bio	61.7	1.8	11.0	89.0	382.6	73.21	63.7	1.7	8.5	89.1	395.0	80.43
13-6 ton/fed. Chicken manure without bio	65.7	1.5	11.2	101.2	401.2	73.16	65.6	1.4	10.4	95.1	390.3	74.11
14-6 ton/fed. Bio-green compost without bio	57.2	1.3	7.7	60.1	330.5	61.52	53.4	1.3	7.3	61.5	335.3	69.33
15- 6 ton/fed. Obour compost without bio	42.4	1.1	5.2	52.0	240.6	48.51	39.3	1.1	6.7	56.3	241.2	47.91
16- 6 ton/fed. EL-Arish compost without bio	51.3	1.2	6.5	44.7	290.3	52.17	42.7	1.2	6.9	57.2	291.6	57.32
17- Control	75.0	2.2	12.0	115.5	465.1	89.70	74.3	2.3	13.6	106.3	460.8	93.83
L.S.D. at 5%	4.8	N.S.	0.4	5.2	21.3	7.17	5.9	N.S.	0.3	4.1	18.7	6.25

2- Yield and its components:

Data in Table (4) show the effect of organic manure and biofertilizer on yield and it's components. Data exhibited that there were significant difference between organic types and levels on total yield/ plant compared with the control. The chicken manure combined with biofertilizer gave the highest total yield/ plant than any other compost type with or without biofertilizer. In other words, the application of different levels of chicken manure combined with biofertilizer recorded higher values of fruit yield per plant ranged from 6.30 to 7.5 kg /plant and from 6.06 to 7.14 kg/plant in the first and second seasons respectively. The highest productivity was obtained by using 6 and 8 ton/fed. of chicken manure combined with biofertilizer. While the lowest total yield/plant was obtained by adding Obour, Arish or Biogreen compost without biofertilizer. The obtained total yield by using these types of compost were 1.47, 1.92 kg/plant in the first and 1.31, 1.96 kg/plant in the second year respectively. This may be due to the high quantity of nutrients in chicken manure than the different types used of compost and to the increasing of biological activity by adding the biofertilizer.

As for total yield per feddan chicken manure at the rate of 8 ton /fed. combined with biofertilizer gave 37.56, 35.70 ton/fed. in the first and second seasons respectively. On the other hand, all sources of compost at the rate of 10 ton/fed, i.e. Obour, Arish and Biogreen combined with biofertilizer produced 12.10, 15.12 and 17.30, and 11.76, 14.17 and 17.14 tons/ fed. in years 2003 and 2004 respectively.

In the mean time the control that received only recommended dose of chemical fertilization without biofertilizer gave 36.6 tons/fed. in the first season and 32.70 in second seasons. Consequently, using chicken manure combined with biofertilizer can be recommended to produce tomato in sandy soil and avoiding using chemical fertilizers.

These results were true during both studied seasons and are in agreement with those described by Warman (1990) and EL-Sheikh and Salama (1997). The same improving effect was found by Montagu and Goh (1990) and Gardini *et al.* (1992) on tomato. *Azospirillum* inoculation increased total yield and average fruit weight of tomato (Shehata *et al.*, 2001 and Darwesh, 2002).

Concerning fruit diameter, fruit length and average fruit weight, Table (4) indicated that no significant difference in fruit diameter was noticed between treatments. The highest fruit length values were obtained under the chicken manure treatments and the lowest ones were due to the addition of Arish or Obour compost. As for the average fruit weight an increment was detected by applying chicken manure + biofertilizer. The lowest average fruit weight was obtained by using Obour compost without biofertilizer.

These results may be attributed to the low levels of compost contents of N, K and organic material at the high level of pH than chicken manure as shown in Table (2).

It can be concluded from the obtained results that heavy fruit weight, fruit length and diameter were obtained by using chicken manure, combined with biofertilizer, especially at the rate of 8 ton/fed. chicken manure + biofertilizer.

Table (4) Effect of some organic manure combined with biological fertilizers on fruit yield and its components of tomato grown in summer seasons of 2003 and 2004.

Season / Treatments	First season of 2003					Second season of 2004				
	Fruit length (cm)	Fruit diameter (cm)	Fruit W. (gm)	Fruit yield/ plant (kg)	Total yield ton/fed.	Fruit length (cm)	Fruit diameter (cm)	Fruit W. (gm)	Fruit yield/ plant (kg)	Total yield ton/fed.
1-6 ton/fed. Chicken manure + bio	5.9	5.5	12.5	7.32	36.60	5.5	5.4	127.7	6.97	34.85
2-8 ton/fed. Chicken manure + bio	6.1	5.9	130.5	7.50	37.56	5.9	5.8	127.9	7.14	35.70
3-10 ton/fed. Chicken manure + bio	5.8	5.6	125.6	6.30	31.52	5.7	5.7	122.3	6.06	30.94
4- 6 ton/fed. Bio-green compost + bio	5.1	4.1	113.3	2.99	16.74	5.2	5.0	110.5	2.91	16.30
5- 8 ton/fed. Bio-green compost + bio	5.2	5.1	117.7	3.01	16.86	5.3	5.3	115.1	3.00	16.80
6-10 ton/fed. Bio-green compost + bio	5.3	5.3	121.8	3.09	17.30	5.4	5.5	119.3	3.06	17.14
7- 6 ton/fed. Obour compost + bio	4.5	4.0	97.3	2.00	11.20	4.3	4.3	89.3	1.94	10.86
8- 8 ton/fed. Obour compost + bio	4.6	5.0	100.2	2.10	11.54	4.5	4.7	92.6	2.01	11.26
9-10 ton/fed. Obour compost + bio	4.8	5.4	104.1	2.16	12.10	4.7	5.0	113.7	2.10	11.76
10- 6 ton/fed. EL-Arish compost + bio	4.1	4.9	118.6	2.21	12.38	4.7	4.7	113.2	2.12	11.87
11- 8 ton/fed. EL-Arish compost + bio	5.1	4.9	120.2	2.47	13.83	5.2	4.9	119.2	2.31	12.94
12-10 ton/fed. EL-Arish compost + bio	5.3	4.0	123.5	2.70	15.12	5.2	5.7	120.0	2.53	14.17
13-6 ton/fed. Chicken manure without bio	5.4	5.1	109.6	6.33	35.20	5.3	5.1	115.5	6.31	33.19
14-6 ton/fed. Bio-green compost without bio	4.8	3.9	95.3	1.92	14.73	4.7	4.0	96.7	1.96	14.52
15- 6 ton/fed. Obour compost without bio	3.9	3.8	85.4	1.47	10.33	3.4	3.7	81.3	1.31	10.21
16- 6 ton/fed. EL-Arish compost without bio	3.3	3.9	91.6	1.83	11.91	3.5	3.9	92.1	1.76	11.72
7- Control (recommended NPK)	5.3	5.6	127.0	7.20	36.63	4.9	5.4	126.0	6.54	32.70
L.S.D. at 5%	0.3	N.S.	8.3	0.53	1.07	0.2	N.S.	6.4	0.47	1.56

These results were true during both studied seasons and agree with those of Hesieh and Hsu (1994), Kumaran *et al.* (1998) and Salam (2002).

3- Chemical constituents:

Data presented in Table (5) showed that NPK contents were higher by using chicken manure compost + biofertilizer than the different types of compost + biofertilizer. The highest amounts of NPK in leaves were obtained by control treatment, followed by chicken manures, Biogreen compost, Arish compost and Obour compost with bio-fertilizer respectively. For N and P the difference between treatments was significant. As for K no significant difference was noticed between any treatment and control.

The percentages of nitrogen and phosphorus in leaf were increased under using the rate of 10 ton/fed. of chicken manure + bio-fertilizer followed by 10 ton of Biogreen compost with bio- fertilizer. The lowest values of NPK percentage were obtained from using Obour compost under the different rates.

Leaf content of total chlorophyll was higher by using chicken manure than the different types of applied compost. The control was significantly higher than all the organic treatments. The lowest total chlorophyll content was obtained by using Obour compost without biofertilizer. As for percentage of acidity and TSS no significant differences were noticed between all types of organic fertilizers and Control. Vitamin C content was significantly higher under chicken manure + biofertilizer treatment than the control and different types of compost. The lowest value of vitamin C was obtained by using Obour compost. Using 10 ton/fed. of chicken manure + biofertilizer increased vitamin C in tomato fruits. These results were true during both studied seasons.

It can be concluded from the mentioned results that chicken manure + bio-fertilizer increased N, P, chlorophyll and vitamin C in tomato during both tested seasons. As for K, acidity and TSS no significant differences were observed between all types of organic fertilizer and control.

These results agree with those achieved by Abou – Hussein *et al.* (2003), Gomaa (1995) and EL-Sheikh and Salama (1997) on Potato, tomato, cucumber and tomato, respectively.

4- Rhizosphere microbial activity:

Data in Table (6) indicate the effect of different types and levels of organic manure ,i.e., Obour compost + bio- fertilizer, Biogreen compost + bio, EL -Arish compost + bio and chicken manure + biofertilizer on microbial activity for the root rhizosphere of tomato plants cultivated in sandy soils at Borollous area. Results revealed that all tested treatments increased significantly all microbial tested parameters in both tested seasons over the control treatment. However, the use of chicken manure + biofertilizer gave the highest percentage of root *Mycorrhiza* colonization, cell count of *Azospirillum* and nitrogenase activity compared to the other tested organic manures + biofertilizer and /or the control treatment in both tested seasons. The highest root colonization percentages were recorded due to the use of 10 ton/fed. chicken manure + biofertilizer in both tested seasons.

Table (5): Effect of some organic manure combined with biological fertilizers on chemical contents of leaves and fruits of tomato grown in summer seasons of 2003 and 2004.

Season / Treatments	First season of 2003							Second season of 2004						
	Leaves chemical content				Fruit chemical content			Leaves chemical content				Fruit chemical content		
	N%	P%	K%	Total Chlo. Leaves mg/100g	Acidity %	V.C. Mg/100g F.W.	T.S.S. %	N%	P%	K%	Total Chlo. Leaves mg/100g	Acidity %	V.C. Mg/100g F.W.	T.S.S. %
1-6 ton/fed. Chicken manure + bio	2.6	0.36	3.35	50.2	0.49	18.6	6.0	2.2	0.32	3.61	50.0	0.52	19.7	5.2
2-8 ton/fed. Chicken manure + bio	2.8	0.46	3.42	50.9	0.51	18.9	4.7	2.6	0.41	3.72	50.7	0.57	20.2	4.9
3-10 ton/fed. Chicken manure + bio	2.9	0.52	3.67	53.3	0.53	19.8	4.6	2.6	0.43	3.81	52.1	0.58	21.7	4.9
4- 6 ton/fed. Bio-green compost + bio	1.2	0.25	3.20	48.2	0.49	15.5	5.9	1.5	0.27	3.22	46.8	0.52	15.6	5.5
5- 8 ton/fed. Bio-green compost + bio	1.6	0.29	3.25	51.4	0.49	15.8	5.5	1.7	0.31	3.37	47.5	0.55	15.6	5.2
6-10 ton/fed. Bio-green compost + bio	1.8	0.31	3.36	51.7	0.52	16.2	5.4	1.7	0.35	3.46	49.0	0.59	16.1	5.1
7- 6 ton/fed. Obour compost + bio	0.8	0.16	2.19	45.9	0.44	13.5	4.5	1.1	0.18	2.16	44.4	0.46	13.0	4.5
8- 8 ton/fed. Obour compost + bio	1.0	0.16	2.21	47.3	0.46	14.3	4.6	1.5	0.10	2.26	46.2	0.49	14.2	4.5
9-10 ton/fed. Obour compost + bio	1.2	0.23	2.32	48.9	0.48	15.1	4.4	1.6	0.21	2.36	47.8	0.49	15.0	4.1
10- 6 ton/fed. EL-Arish compost + bio	1.0	0.21	2.11	49.0	0.48	14.3	4.7	0.9	0.22	2.24	47.3	0.49	14.3	4.5
11- 8 ton/fed. EL-Arish compost + bio	1.4	0.25	2.17	50.0	0.49	15.7	4.2	1.2	0.26	2.43	47.8	0.49	16.5	4.5
12-10 ton/fed. EL-Arish compost + bio	1.6	0.27	2.29	50.0	0.51	16.2	4.0	1.8	0.29	2.53	49.2	0.50	16.6	4.1
13-6 ton/fed. Chicken manure without bio	2.4	0.33	3.20	48.6	0.47	17.6	5.8	2.0	0.31	3.31	48.5	0.48	1.79	5.2
14-6 ton/fed. Bio-green compost without bio	1.1	0.23	2.91	45.2	0.45	14.3	4.9	1.2	0.24	2.92	43.3	0.46	14.1	4.5
15- 6 ton/fed. Obour compost without bio	0.7	0.15	1.91	43.1	0.42	12.1	3.9	0.7	0.16	1.90	41.2	0.42	12.0	3.8
16- 6 ton/fed. EL-Arish compost without bio	0.9	0.19	1.60	44.6	0.45	13.2	4.0	0.8	0.18	1.72	42.9	0.44	13.1	3.9
17- Control	3.6	0.49	3.71	58.7	0.53	19.1	4.2	3.4	0.47	3.81	57.6	0.56	19.6	4.0
L.S.D. at 5%	0.3	0.07	N.S.	2.6	N.S.	0.6	N.S.	0.4	0.08	N.S	3.1	N.S	0.4	N.S

Table (6): Effect of some organic manure combined with biofertilizers on microbiological activity of root rhizosphere tomato cultivated in sandy soils in summer seasons of 2003 and 2004

Treatments	First season of 2003			Second season of 2004		
	Root coloniza-tion %	Nitrogenase Acticity (µmole C_2H_4 g^{-1} dry root h^{-1})	No. of *Azospirillum* cell x 10^5	Root colonization %	Nitrogenase Acticity (µmole C_2H_4 g^{-1} dry root h^{-1})	No. of Azospirillum cell x 10^5
1-6 ton/fed. Chicken manure + bio	60.667	424.667	8.600	56.667	412.667	7.600
2-8 ton/fed. Chicken manure + bio	63.667	444.667	8.633	58.667	423.333	7.767
3-10 ton/fed. Chicken manure + bio	65.333	447.333	9.567	67.333	438.333	8.300
4- 6 ton/fed. Bio-green compost + bio	38.667	249.000	3.200	37.000	256.667	3.900
5- 8 ton/fed. Bio-green compost + bio	42.333	271.000	3.767	39.000	272.333	4.700
6-10 ton/fed. Bio-green compost + bio	43.000	300.333	4.567	40.000	315.000	4.800
7- 6 ton/fed. Obour compost + bio	25.000	71.333	1.933	16.000	104.000	2.267
8- 8 ton/fed. Obour compost + bio	24.667	106.667	2.233	18.667	122.000	2.367
9-10 ton/fed. Obour compost + bio	25.667	144.000	3.133	23.000	160.333	2.933
0- 6 ton/fed. EL-Arish compost + bio	53.333	357.667	6.267	43.250	356.333	6.200
1- 8 ton/fed. EL-Arish compost + bio	52.000	372.000	6.300	48.000	372.333	6.633
2-10 ton/fed. EL-Arish compost + bio	52.667	389.667	7.500	50.667	379.667	7.133
3-6 ton/fed. Chicken manure without bio	53.824	415.326	7.511	51.613	398.673	6.413
4-6 ton/fed. Bio-green compost without bio	31.336	211.361	2.946	30.663	201.246	3.221
5- 6 ton/fed. Obour compost without bio	21.732	062.724	1.523	14.312	101.610	1.734
6- 6 ton/fed. EL-Arish compost without bio	46.693	332.916	5.719	36.261	336.633	5.732
7- Control (recommended NPK)	12.667	65.000	1.933	16.667	87.000	1.133
L.S.D. at 5%	11.886	29.605	2.693	14.740	22.909	0.699

Same trend and results were achieved by both *Azospirillum* cell count and nitrogenase activity due to the response of different organic manure types combined with biofertilizer. The corresponding highest values for both cultivated seasons were 447.333 and 438.33 µmole C_2H_4 g^{-1} dry root h^{-1} for nitrogenase activity and 9.567 and 8.300 x 10^5 Cell for *Azospirillum* count. These recorded results were significantly higher from some of the tested treatment and were not with the others. For instance, the root colonization percentages given by the use of chicken manure + biofertilizer were significantly higher than those recorded by the use of Obour compost + biofertilizer but were not in case of Biogreen compost + biofertilizer. However, it can be inferred that the use of chicken manure + biofertilizer gave the highest microbial activity for the root rhizosphere of tomato plants cultivated in sandy soils.

In the present study, the significant increases in tomato yield and its components due to organic manure and biofertilizers application were previously discussed in other crops by many authors. Ragab and Rashad (2003) showed that inoculation of sorghum with effective nitrogen fixing bacteria improved its growth and increased its yield components, they not only fix nitrogen but also they secreted effective plant growth promoting substances such as auxins, gibberellins and cytokines eliciting root metabolism activity with bacterial surface components. They also added that inoculation enhanced the root *Mycorrhiza colonization* and nitrogenase activity in the rhizosphere area.

Addition of biofertilizers increased N-ase activity, in this respect, Kanugo (1997) reported that higher N-ase activity was associated organic manure application, which led to greater populations of nitrogen fixing *Azospirulum* sp., .He also added that inoculation with *Azospirillum* combined with mycorrhiza increased significantly maize root volume and root mycorrhiza colonization.

The aforementioned results led to conclude that inoculation with *Azospirillum* + mycorrhiza combined with chicken manure ensured better tomato yield with good physical quality and save the environment from the pollution resulting from the extensive use of mineral fertilizer.

It could be concluded also that the biofertilizers improved the total yield of tomato plants when added to the organic fertilizers.

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تأثير أنواع ومستويات مختلفة من التسميد العضوى ملقح بالسماد الحيوى على النمو ومحصول الطماطم فى الأراضى الرملية

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نفذت تجربة حقلية تحت ظروف الأراضى الرملية بموقع البرلس شمال دلتا النيل محافظة كفر الشيخ فى موسمين صيفين متتالين ٢٠٠٣، ٢٠٠٤ لدراسة تأثير أنواع ومستويات مختلفة من الأسمدة العضوية مع معاملة النباتات بواسطة الميكروهيزا وبكتريا الايزوسبيريليم كأسمدة حيوية على نمو نباتات الطماطم والمحصول ومكوناته وصفات الثمار كذلك نشاط الميكروهيزا فى منطقة انتشار الجذور وكذلك محتوى الخلية من نشاط ايزوسبيريليم والنتروجين.

وقد أوضحت النتائج أنه تم الحصول على أعلا معدلات للنمو ممثلة فى طول الساق عدد الأفرع والأوراق والوزن الطازج والجاف بإضافة ١٠ طن/فدان من سماد الدواجن مع الأسمدة الحيوية وعلى العكس سجلت أقل القيم بإضافة كل معاملات الكمبوست فى تلك الدراسة وهى العبور – بيوجرين والعريش مع الأسمدة الحيوية أما بالنسبة للمحتويات الكيماوية فى الأوراق ممثلة فى النيتروجين والفوسفور والبوتاسيوم والكلوروفيل ومحتويات الثمار من الحموضة، فيتامين C ، المواد الذائبة الصلبة الكلية، فقد أوضحت النتائج زيادة محتوى الأوراق من الكلوروفيل، النيتروجين، الفوسفور. كذلك محتوى الثمار من فيتامين C وذلك باستخدام سماد الدواجن مع الأسمدة الحيوية عن كل أنواع الكومبوست المستخدمة. وقد أعطت نباتات الطماطم المسمدة بسماد الدواجن بمعدل ٨ طن للفدان مع الأسمدة الحيوية أعلا محصول مقارنة بالمعاملات الأخرى فى هذه الدراسة. وبالنسبة للنشاط البكتيرى فى منطقة جذور نباتات الطماطم فقد أدت كل المعاملات إلى زيادة معنوية فى كل قياسات النشاط البكتيرى المستخدمة عن معاملة الكنترول. بينما كان لاستخدام سماد الدواجن + المخصبات الحيوية أعطى أعلا نشاط عن بقة المعاملات العضوية الأخرى فى وجود الأسمدة الحيوية كذلك معاملة الكونترول وعليه يمكن التوصية بان استخدام سماد الدواجن بمعدل ٨ طن/ فدان + الأسمدة الحيوية (ميكروهيزا _ الأيزوسبيريليم) أعطى أعلى محصول لثمار الطماطم وبمواصفات جيدة مع زيادة النشاط البكتيرى فى منطقة جذور نباتات الطماطم تحت ظروف الزراعة بالأراضى الرملية ومع إنتاج محصول من ثمار الطماطم بدون استخدام أسمدة كيماوية خالية من أى متبقيات كيماوية.