Zagazig J. Agric. Res., Vol. 43 No. (2) 2016
http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

THE INFLUENCE OF ORGANIC, BIO AND MINERAL ORE MIXTURE FERTILIZERS ON YIELD AND QUALITY OF TOMATO UNDER NORTH SINAI CONDITIONS

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ABSTRACT

A field study was carried out during summer seasons of 2014 and 2015 at the Experimental Farm of the Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University. It aims to study the effect of organic, bio and a mixture of natural mineral ore fertilizers on the productivity and quality of tomato fruits using local hybrid "Alisa" under sandy soil conditions using drip-irrigation system. The experiment included nine treatments as follows: T_1= 5.7 ton of compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T_2= 11.4 ton of compost/fad. (80kg N), T_3= 17.1 ton of compost/fad. (120kg N), T_4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T_5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T_6= 11.4 ton of compost/fad. (80kg N) + 400 g/fad. nitrogen fixing bacteria containing (NFB) *Azotobacter chroococcum*, T_7= 17.1 ton of compost/fad. (120kg N) + NFB, T_8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad. mixture of natural mineral ore, T_9=- 17.1 ton of compost/fad., (120kg N) + 1 ton/fad. mixture of natural mineral ore + NFB. Application of 17.1 ton of compost/fad. (120 kg N/fad.) + one ton/ fad., mixture of natural mineral ore + NFB recorded the highest significant values of total fresh and dry weight, leaf area/ plant, growth attributes, photosynthetic pigments, early and total yield as well as fruit quality.

Key words: Organic fertilizer, bio-fertilizer, mineral ore mixture, yield, tomato.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of popular and most consumed vegetables in the world and considered an essential component for human diet for supplying of vitamins, minerals and certain types of hormones precursors (Sainju *et al.,* 2003).

Nowadays a great attention has been directed towards the use of organic and bio-fertilizers as well as some natural materials to reduce plant and soil contaminations and to improve the fertility and soil conditions of sandy soil to produce safe products for human consumption.

The organic fertilizers take the place of inorganic fertilizers in sustainable agriculture. The main sources of the organic fertilizers are composted livestock manures, plant residues and industrial wastes. The organic fertilizers provide the nutritional requirements of plants and also suppress the plant pest populations. Additionally, they increase the microbial activity in soil, anion and cation exchange capacity, organic matter and carbon-content of soil and this directly reflect on improving yield and quality of agricultural crops in ways similar to inorganic fertilizers (Heeb *et al.*, 2006; Liu *et al.*, 2007; Tonfack *et al.*, 2009). Moreover, application of 40 m^3/fad., of chicken manure resulted in the highest values of fresh weight of leaves/plant, branches/plant, root/ plant, dry weight of root/ plant and total dry weight of tomato plant (Darwesh, 2002). Also, El-Nagar (2004) and Bayoumi (2005) reported that application of compost to tomato plants led to significant

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increase in fresh and dry weight/plant compared to control treatment. Moreover, El-Kassas and Abd El-Mowly (1999) found that using chicken manure and/or pressed olive cake alone or combined led to the highest values of N, P and K content in leaf tissues of tomato plant.

Bio fertilizers is a natural products carrying living microorganisms which don't have any adverse effects on soil health and environment, besides its role in atmospheric nitrogen fixation, it also help in stimulating plant growth hormones providing better nutrient uptake. A small dose of bio fertilizer is sufficient to produce desirable results because each gram of carrier of bio fertilizers (biogein) contains at least 10 million viable cells of a specific strain; *i.e.*, *Azotobacter* or *Azospirillum*(Ramakrishnan and Selvakumar, 2012). Also, Mustafa *et al.* (1993) found that inoculation of tomato seedlings with *Azospirrilum brasilense* under half and full nitrogen fertilization increased dry weight/plant. In addition, Yuki *et al.* (1994) found that inoculation with *Azotobacter* sp. led to increasing fresh and dry matter of tomato plant as compared to untreated plants. Moreover, Antipchuk *et al.* (1982) and Mohandas (1987) reported that inoculation of tomato seedlings with *Azotobacter* (through soil or root treatment) led to increasing fruit yield of tomato plant. So, the present research aimed to study the effect of organic, bio and natural mineral ore mixture fertilizers on the productivity and quality of tomato fruits under sandy soil conditions in order to produce safe tomato fruits for human consumption and prevent soil contamination with chemical fertilizers.

MATERIALS AND METHODS

A field experiment was carried out during summer seasons of 2014 and 2015 at the Experimental Farm, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University. It aims to study the effect of organic and bio- fertilizers and a mixture of natural mineral ore on the productivity and quality of tomato grown in sandy soil.

Random samples were collected from the experimental soil site at the beginning of the experiment and physical and chemical prosperities of the soil were as follows (average of two seasons) : OM = 0.18%, pH=8.2, EC = 0.8 and available N, P and K were 16.52 ppm, 46.5 and 97.50 ppm, respectively.

The soil was sandy in texture, it comprised of 68.0% coarse sand 20.57% fine sand, 3.50 silt and 7.90 clay (average of two seasons). Seeds of Tomato 'Alisa' hybrid were sown on 15th and 16th February in the first and second seasons, respectively in seedling trays under plastic house conditions. Seedlings were transplanted on 3rd and 6th April in 2014 and 2015 seasons, respectively besides the emitters of dripper lines. The distance between every two dripper lines was 150 cm, but the distance between plants in the same line was 50 cm. The plot area was 12 m^2 (8.0 m length and 1.5 m width).

The analysis of organic fertilizers and the mixture of natural mineral ore are presented in Table 1.

A complete randomized block design was used and the treatments were randomly distributed with three replications.

Compost and mixture of natural mineral ore were added during soil preparation. The experimental plots of T1 (as control) received equal amounts of fertilizers; *i.e.*, 160 Kg potassium sulfate (48-52% K_2O), and 45 Kg P_2O_5 from orthophosphoric acid (85%) and added (in different portions) as recommended for drip irrigation of tomato. The other agricultural practices for growing tomato under El-Arish, North Sinai region (drip irrigation, weed disease and pest control were carried out whenever needed). The other eight treatments (from T2 to T9) received the agriculture practices (weed, disease and pest control) as followed in the organic farming of tomato in Egypt

The source of nitrogen fixing bacteria (NFB) was the Agriculture Research Center, Cairo, Egypt. The NFB contained *Azotobacter chroococcum* was added at a rate of 400 g/fad. Before transplanting, seedlings were inoculated with NFB by dipping roots portion of seedlings in NFB liquid suspension (prepared by mixing 400g bio-fertilizer culture in four liters of water) for 20 min then transplant immediately.

Table 1. Chemical analysis of organic fertilizer compost and mixture of the natural mineral ore

Parameter	Organic fertilizer compost		Mixture of the natural mineral ore	
	Season (2014)	Season (2015)	Parameter (%)	Value
Total N (%)	0.71	0.69	SiO_2	37.3-38.8
Total P (%)	0.39	0.49	TiO_2	1.17-1.25
Total K (%)	0.42	0.29	Al_2O_3	6.38-7.87
Total Fe (ppm)	1110	1188	Fe_2O_3	3.31-3.39
Total Cu (ppm	123	110	MnO	0.07-0.12
Total Zn (ppm)	219	214	MgO	2.40-3.38
Total Mn (ppm)	170	166	CaO	14.4-16.8
Organic matter (%)	30.20	24.05	Na_2O	1.59-1.60
Organic carbon (%)	12.88	13.95	K_2O	4.28-4.35
C/N (%)	18.14	20.20	P_2O_5	6.86-8.22
			SO_3	5.93-6.40

Organic fertilizer compost source was the Center Laboratory of Organic Agriculture, Agric. Res. Center, Ministry of Agriculture, while mixture of the natural mineral ore source was Central Laboratories Sector, the Egyptian Mineral Resources Authority, Cairo, Egypt.

This experiment included nine treatments as follows: T_1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/fad., from ammonium sulfate (20.5% N) as control, T_2= 11.4 ton of compost/fad. (80kg N), T_3= 17.1 ton of compost/fad. (120kg N), T_4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T_5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T_6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria(NFB) containing *Azotobacter chroococcum,* T_7= 17.1 ton of compost/fad. (120kg N) + NFB, T_8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB T_9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad. mixture of natural mineral ore + NFB.

Samples each of three plants were randomly taken from each plot 30, 45 and 60 days after transplanting to determine total fresh weight/ plant, leaf area, root dry weight/ plant, leaves dry weight/ plant, stem dry weight/plant, and total dry weight/ plant. The growth attributes; *i.e.*, crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) were computed according to Watson (1958). At 55 days from transplanting leaf pigments; chlorophyll a, chlorophyll b and carotenoids were determined according to Moran (1982). Total nitrogen, phosphorus and potassium were determined in dried leaves at 60 days after transplanting and in fruits (taken from the third harvest) using the method described by Bremner and Mulvaney (1982), Piper (1950) and Brown and Lilliand (1946), respectively. Number of fruits per plant, average fruit weight (g) of all harvests were recorded, then yield per plant (kg) and both early yield (from the first three pickings) and total yield (ton per fad.), were calculated. A random sample of five fruits at the red ripe stage (from the third picking) were taken from each experimental unit to determine total soluble solids (TSS%) using a hand refractometer and vitamin C content (VC) as described by AOAC (1990).

Obtained data were statistically analyzed using the statistical analysis of variance according to Snedecor and Cochran (1980). Duncan's multiple range tests was used for comparison among means (Duncan, 1958).

RESULTS AND DISCUSSION

Plant Growth

Data in Table 2 show that application of 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB (T9) and (T8) 17.1 ton of compost/ fad. (120kg N) +

Table 2. Effect of organic, bio-fertilizers and mixture of the natural mineral ore on fresh weight of tomato plants and leaf area during 2014 and 2015 seasons

Character / Treatment	Fresh weight/ plant (g)		Leaf area/ plant (m^2)	
	Days after transplanting			
	45	60	45	60
	Season (2014)			
T_1	740.7 c	1025 b	1.673 e	1.850 de
T_2	444.7 g	641.7 e	1.543 f	1.763 ef
T_3	719.7 c	936.0 c	1.640 e	1.747 f
T_4	572.3 e	747.3 d	1.737 d	1.937 d
T_5	725.0 c	952.0 c	1.760 cd	2.180 c
T_6	542.7 f	777.3 d	1.807 bc	2.203 c
T_7	770.7 b	1060 b	1.830 ab	2.373 b
T_8	657.3 d	924.3 c	1.867 a	2.633 a
T_9	805.3 a	1105 a	1.880 a	2.717 a
	Season (2015)			
T_1	702.0 c	1014 b	1.700 de	1.867 e
T_2	448.0 f	628.0 e	1.557 f	1.763 f
T_3	699.3 c	922.3 c	1.653 e	1.827 ef
T_4	568.7 e	733.0 d	1.713 de	1.923 e
T_5	733.7 bc	944.3 c	1.747 d	2.083 d
T_6	556.7 e	777.7 d	1.833 c	2.257 c
T_7	766.3 ab	1053 ab	1.850 c	2.450 b
T_8	657.3 d	919.3 c	1.930 b	2.693 a
T_9	792.0 a	1091 a	2.107 a	2.717 a

* Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of probability.
T1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T2= 11.4 ton of compost/fad. (80kg N), T3= 17.1 ton of compost/fad. (120kg N), T4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria (NFB), T7= 17.1 ton of compost/fad. (120kg N) + NFB, T8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, T9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB.

NFB recorded the highest values of total fresh weight/plant and leaf area/ plant with no significant difference between them in the second season only, regarding total fresh weight/ plant. It is interest to note that the application of 17.1 ton of compost/fad. (120kg N)+ mixture of natural mineral ore + NFB, followed by (T8) 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB and (T7) in most studied traits gave the highest values of dry weight of different plant parts (roots, stems, leaves) and total dry weight / plant in both seasons at different sampling dates (Table 3).

Science sandy soil had low organic matter and also had low mineral nutrients, (as described in soil chemical analysis of this study), In this regard; compost and NFB as well as mixture mineral ore fertilizers added to the soil can improve soil conditions (N, P and K availability to plant), consequently increase root growth, cell division and enlargement. As a result, this might be reflected on plant growth of tomato. In addition, the highest values, in this respect, were obtained with (T9) followed by (T7) with no significant differences between them, in the second season only.

Table 3. Effect of organic, bio- fertilizers and mixture of natural mineral ore on dry weight of tomato plants during 2014 and 2015 seasons

Character / Treatment	Dry weight/ plant part (g)											
	Roots			Leaves			Branches			Total		
	Days after transplanting											
	30	45	60	30	45	60	30	45	60	30	45	60
	Season (2014)											
T_1	2.85e	17.80cd	19.80de	31.33c	83.30d	112.5c	6.03b	30.87bc	32.77bcd	40.22cd	132.0c	165.1cd
T_2	2.55f	15.13f	16.83f	24.00f	72.87f	93.93e	3.96d	21.50f	24.37e	30.52g	109.5e	135.1f
T_3	2.75e	16.67e	19.31e	30.20d	82.57d	112.3c	5.76bc	30.23c	31.03cd	38.72e	129.5c	162.6d
T_4	3.66cd	17.53 d	19.83de	28.33 e	80.47e	106.0d	5.23c	26.47e	30.17d	37.23f	124.5d	156.0e
T_5	3.88b	18.49c	20.47d	31.40c	84.27d	112.7c	6.03b	29.20d	33.20bcd	41.32bc	132.0c	166.4cd
T_6	3.53d	18.37cd	21.37c	30.63cd	86.47c	112.9c	5.25c	27.00e	34.20cd	39.42de	131.8c	168.5c
T_7	3.80bc	20.83b	23.30b	32.50b	92.00b	115.4b	6.06b	31.63b	35.10bc	42.37b	144.5b	173.8b
T_8	3.83b	20.73b	23.67b	31.50c	91.03b	115.2b	5.60bc	30.87bc	36.53 b	40.93c	142.6b	175.4b
T_9	4.16a	21.70a	24.57a	34.40a	94.40a	118.2a	6.96a	34.23a	41.40a	45.53a	150.3a	184.1a
	Season (2015)											
T_1	2.95e	18.77ab	19.37e	31.27cd	87.03e	113.0c	5.86cd	31.03b	37.27cd	40.08d	136.8c	169.6cd
T_2	2.51f	13.30b	17.33f	24.60f	73.90g	94.20e	3.70f	21.67e	26.40g	30.82g	108.9.4e	137.9f
T_3	2.93e	17.53ab	19.03e	30.30d	88.80de	112.9c	5.60d	30.20b	35.17e	38.83e	136.5c	167.1d
T_4	3.83c	18.57ab	19.47e	28.50e	83.47f	105.9d	4.80e	26.50d	33.30f	37.13f	128.5d	158.7e
T_5	3.92c	19.43ab	21.77d	32.37bc	90.47cd	112.4c	6.13bc	30.93b	36.27de	42.43bc	140.8bc	170.5cd
T_6	3.55d	15.80ab	22.27cd	30.20d	87.33e	113.7c	4.90e	27.87c	35.20e	38.65e	131.0d	171.2c
T_7	3.81c	21.27a	23.02c	33.20b	93.47ab	117.1b	6.50b	31.47b	41.20b	43.51b	146.2ab	181.3b
T_8	4.11b	21.47a	23.87b	32.43bc	92.50bc	117.5b	5.63d	31.03b	38.50c	42.18c	145.0b	179.8b
T_9	4.42a	22.18a	25.33a	35.77a	95.50a	120.3a	7.10a	35.23a	44.27a	47.29a	152.9a	189.9a

* Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of probability.
T1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T2= 11.4 ton of compost/fad. (80kg N), T3= 17.1 ton of compost/fad. (120kg N), T4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria (NFB), T7= 17.1 ton of compost/fad. (120kg N) + NFB, T8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, T9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB.

The obtained results may be due to the effect of compost on soil physiochemical and biological properties as reported by Darwesh (2002). The increment in fresh and dry weight of tomato plant may be due to the simulative effect of the above mentioned organic fertilizer treatments on the meristematic activity of plant tissues, where these treatments contained adequate nutrients required for plant growth as reported by Safia *et al.* (2001). Also the obtained results are in agreement with those reported by El-Ghanam *et al.* (2005) who found that organic fertilizer application caused a reduction in soil pH in the rihzosphere zone which may be due to the formation of CO_2 and other organic acids during decomposition of the organic fertilizer. Also, organic fertilizer contributes through: release of nutrients, reducing nutrients fixation, and production of humates. In addition, many researchers indicated that organic fertilizers may increase soil fertility which reflected on the crop production potential possibly affected by changes in soil physical and chemical properties including nutrient bioavailability, soil structure, water holding capacity, cation exchange capacity, soil pH and microbial community and activity (Muhammad and Khattak, 2009; Ayeni *et al.,* 2010).

Growth Attributes

Significant effects due to the tested treatments application on crop growth rate (CGR) and net assimilation rate (NAR) in both seasons, while it did not reflect significant effect on relative growth rate (RGR) as shown in Table 4. Concerning crop growth rate, the highest values were recorded with application of (T9)17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB with no significant differences when compared with application of 17.1 ton of compost/fad. (120kg N) + NFB or 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB. Regarding net assimilation rate, the highest values were observed with application of (T9) 17.1 ton of compost/fad. (120 kg N/fad.) of compost + mixture of natural mineral ore ,(T8) 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB and (T7) 17.1 ton of compost/fad. (120 kg N) NFB with no significant differences among them in both seasons.

This enhancing effect may be due to the positive effects of the applied organic fertilizer which had high content of N as well as the different nutrients involved in the mixture of natural mineral ore (Table 1). Under the same conditions at El-Arish region, Abo El-Kasem (2006 and 2011) obtained similar results. Obtained results are in harmony with the results of Bayoumi (2005) who found that application of organic manure sources had a higher significant effect on NAR at all stages of tomato growth.

Photosynthetic Pigments

Application of organic, bio-fertilizers and mixture of mineral ore had significant effects on all studied photosynthetic pigments in both seasons, except chlorophyll a/b in the first one as shown in Table 5. It is clear that the highest chlorophyll a, b and carotenoids content were recorded with application of 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore NFB followed, in general, by application of 17.1 ton of compost/fad. (120kg N) + NFB (T7) then (T8) 11.4 ton of compost/fad., (80 kg N) + 1 ton/fad., mixture of natural mineral ore + NFB and (T5) compared to other treatments.

The enhancing effect of application of compost, NFB + mixture mineral ore on photosynthetic pigments might be owe to that the compost contains high level of nitrogen and NFB fix nitrogen in the rhizosphere. Moreover, N is the main constituent of the amino acids and hence proteins and lipids as glactolipids, acting as a structural components of the chloroplasts. Correspondingly, an enhancement of protein, enzymes, hormones synthesis and chloroplast formation leads to an increase in chlorophyll and carotenoids (Marschner, 1995; Reddy and Reddi, 2002). These results are in agreement with those reported by Abo El-Kasem (2006 and 2011) under similar conditions at El-Arish region.

Leaves and Fruits Content of N, P and K

Data in Table 6 show that application of different organic and biofertilizer beside the mixture of mineral ore increased significantly N, P and K content in tomato leaves and fruits in both studied seasons (2014 and 2015). It is clear that the highest values of N, P and K in leaves and fruits were recorded with application of 17.1 ton of compost / fad., (120 kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, followed, in general, by application of 17.1 ton of compost/fad., (120 kg N) + NFB (T7) , (T1) 5.7 ton compost/ fad., (40 kg N) + 80kg N/fad., from ammonium sulfate (20.5% N) as control and (T5) 17.1 ton of compost/fad., (120 kg N) + 1 ton natural mineral ore mixture/ faddan.

The favorable effect of combined application of compost + mixture of natural mineral ore + NFB in the present study on the content of N, P and K in leaves and fruits of t o mato plant may

Table 4. Effect of organic, bio- fertilizers and mixture of natural mineral ore on crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) of tomato plant during 2014 and 2015 seasons

Treatment \ Character	CGR (g/m²/day)		RGR (g/g/day)		NAR (mg/dm²/day)	
	Days after transplanting					
	30-45	45-60	30-45	45-60	30-45	45-60
			Season (2014)			
T_1	6.117 ab	2.207 ab	0.030 a	0.010 a	300.5 ab	96.8 cd
T_2	4.467 c	1.707 b	0.030 a	0.010 a	264.4 b	91.3 d
T_3	6.053 ab	2.213 ab	0.033 a	0.010 a	349.3 a	127.7 a
T_4	5.817 b	2.103 ab	0.036 a	0.010 a	310.2 ab	111.7 abcd
T_5	6.040 ab	1.907 ab	0.030 a	0.010 a	300.9 ab	114.4 abcd
T_6	6.160 ab	2.187 ab	0.036 a	0.010 a	301.4 ab	119.5 abc
T_7	6.803 a	2.297 a	0.040 a	0.006 a	318.3 ab	101.1 bcd
T_8	6.780 a	2.253 a	0.040 a	0.010 a	297.5 ab	95.9 d
T_9	6.987 a	2.447 a	0.030 a	0.010 a	339.6 a	122.5 ab
			Season (2015)			
T_1	6.450 bcd	2.187 bc	0.040 a	0.010 a	316.6 cd	100.5 b
T_2	5.370 e	1.770 c	0.040 a	0.010 a	287.0 e	99.1 b
T_3	6.517 bc	2.040 bc	0.040 a	0.010 a	366.1 a	136.4 a
T_4	6.093 cd	2.007 bc	0.040 a	0.010 a	327.9 c	108.2 b
T_5	6.560 abc	1.973 bc	0.036 a	0.006 a	335.9 bc	101.0 b
T_6	5.990 d	2.463 ab	0.036 a	0.010 a	287.3 e	107.4 b
T_7	6.847 ab	2.343 abc	0.036 a	0.010 a	313.2 cd	104.2 b
T_8	6.853 ab	2.323 abc	0.040 a	0.010 a	292.5 de	114.7 ab
T_9	7.040 a	2.843 a	0.030 a	0.010 a	353.7 ab	119.9 ab

* Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of probability.
T1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T2= 11.4 ton of compost/fad. (80kg N), T3= 17.1 ton of compost/fad. (120kg N), T4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria (NFB), T7= 17.1 ton of compost/fad. (120kg N) + NFB, T8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, T9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB.

Table 5. Effect of organic, bio-fertilizers and mixture of natural mineral ore on photosynthetic pigments content (mg/g FW) of tomato leaf tissues after 55 days from transplanting during 2014 and 2015 season

Treatment \ Character	Chlorophyll a	Chlorophyll b	Chlorophyll a+b	Chlorophyll a/b	Carotenoids
			Season (2014)		
T_1	3.10 d	3.76 bc	6.86 b	0.82 a	3.90 c
T_2	2.33 h	2.63 f	4.96 e	0.88 a	2.20 f
T_3	2.66 f	2.96 e	5.63 d	0.90 a	3.50 e
T_4	2.53 g	3.10 e	5.63 d	0.81 a	3.43 e
T_5	3.43 ab	3.90 b	7.33 a	0.88 a	3.96 c
T_6	2.93 e	3.40 d	6.33 c	0.86 a	3.70 d
T_7	3.33 bc	4.00 ab	7.33 a	0.83 a	4.40 b
T_8	3.30 c	3.63 cd	6.93 b	0.90 a	4.26 b
T_9	3.53 a	4.23 a	7.76 a	0.83 a	4.70 a
			Season (2015)		
T_1	3.06 c	3.53 cd	6.60 c	0.86 bc	4.00 c
T_2	2.03 f	2.00 f	4.03 f	1.02 a	2.33 f
T_3	2.66 e	3.36 de	6.03 d	0.79 d	3.40 e
T_4	2.56 e	3.16 e	5.72 e	0.81 cd	3.50 e
T_5	3.33 bc	3.96 b	7.30 b	0.84 cd	4.16 bc
T_6	2.90 d	3.40 cde	6.30 d	0.85 bcd	3.76 d
T_7	3.26 b	3.86 b	7.12 b	0.84 cd	4.33 b
T_8	3.36 b	3.70 bc	7.06 b	0.91 b	4.20 bc
T_9	3.63 a	4.33 a	7.96 a	0.83 cd	4.66 a

* Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of probability.
T1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T2= 11.4 ton of compost/fad. (80kg N), T3= 17.1 ton of compost/fad. (120kg N), T4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria (NFB), T7= 17.1 ton of compost/fad. (120kg N) + NFB, T8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, T9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB.

Table 6. Effect of organic, bio- fertilizers and mixture of natural mineral ore on total N, P and K percentages in leaves (at 60 days after sowing) and fruits (from the third harvest) of tomato plant during 2014 and 2015 seasons

Character / Treatment	N (%)		P (%)		K (%)	
	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits
Season (2014)						
T_1	3.03 cd	1.46 bcd	0.73 ab	0.61 ab	3.10 c	4.26 b
T_2	2.53 e	1.13 f	0.54 e	0.43 d	2.00 e	2.96 e
T_3	2.93 cd	1.43 cde	0.70 abc	0.59 bc	2.90 d	4.03 d
T_4	2.86 d	1.33 e	0.65 cd	0.55 c	2.90 d	4.03 d
T_5	3.10 bc	1.53 bc	0.70 abc	0.62 ab	3.33 b	4.13 cd
T_6	3.10 bc	1.36 de	0.62 d	0.60 abc	2.93 cd	4.03 d
T_7	3.26 ab	1.56 b	0.69 abc	0.64 ab	3.33 b	4.26 b
T_8	3.13 bc	1.43 cde	0.67 bcd	0.62 ab	3.06 cd	4.20 bc
T_9	3.43 a	1.76 a	0.75 a	0.66 a	3.63 a	4.66 a
Season (2015)						
T_1	3.20 b	1.46 bc	0.72 ab	0.62 bc	3.30 b	4.20 bc
T_2	2.43 e	1.00 e	0.52 d	0.43 d	2.06 d	2.76 e
T_3	3.00 cd	1.36 cd	0.67 bc	0.59 bc	2.83 c	4.03 d
T_4	2.90 d	1.33 d	0.66 bc	0.58 c	2.86 c	4.00 d
T_5	3.10 bc	1.40 bcd	0.71 ab	0.63 abc	3.16 b	4.06 cd
T_6	3.13 bc	1.33 d	0.67 bc	0.62 bc	2.90 c	4.00 d
T_7	3.06 bc	1.50 b	0.70 abc	0.65 ab	3.13 b	4.23 b
T_8	3.20 b	1.50 b	0.65 c	0.63 abc	2.86 c	4.13 bcd
T_9	3.50 a	1.73 a	0.76 a	0.69 a	3.50 a	4.66 a

* Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of probability.
T1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T2= 11.4 ton of compost/fad. (80kg N), T3= 17.1 ton of compost/fad. (120kg N), T4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria (NFB), T7= 17.1 ton of compost/fad. (120kg N) + NFB, T8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, T9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB.

be due to the high levels of N, P, K and other nutrients which were available for tomato plants, so plants absorb these available amounts of nutrients grew well and recorded the highest contents of N, P and K in leaves and fruits. These results agree with those reported by Adekiya and Agbede (2009) and Ayeni *et al.* (2010) who found increases in tomato leaves and fruits content of N, P and K with application of organic and bio-fertilizers.

Fruit Yield and Quality

The highest early yield ton/fad., was recorded with application of 120kg N/fad., of compost + mixture of natural mineral ore + NFB, followed by 120kg N/fad., of compost + NFB (Table 7). These results may be due to the increases in plant growth, photosynthetic pigments, and increases in dry weight which reflected in increment of yield. These results are in harmony with those reported by El-Mansi *et al.* (2004) and Bayoumi (2005). In this connection, Abo El-Kasem (2006 and 2011) found that application of organic fertilizers with NFB resulted in increasing early yield and its components; *i.e.,* number of fruits/ plant, average fruit weight.

Results in Table 7 show also that the highest values of average fruit weight, number of fruits / plant, yield/plant and/ fad., were obtained with application of 120kg N/fad., of compost + mixture of natural mineral ore+ NFB (T9), followed by (T7) application of 120kg N/fad., of compost + NFB. These increment in yield of tomato might be owe to the increase in plant dry weight/ plant (Table 3) and also to number of fruits/plant and average fruit weight (Table 7) indicate that application of compost at 120kg N/fad. of compost + NFB improved physical and chemical properties of the experimental soil, beside application of a mixture of natural mineral ore which contained several elements, which encouraged plant growth, and this directly reflected on improving the plant to have good root development growth and productivity markedly. It is well known that application of organic fertilizer (compost) enhanced soil aggregation, soil aeration and increased its water holding capacity and offers good environmental conditions for the growth and development of root system of tomatoes. In addition, organic fertilizers slow release nutrients allover the growth season. The favorable conditions creates better nutrients absorption and favors the growth and development of root system which reflected in better vegetative growth, photosynthetic activity and dry matter accumulation . Consequently, higher total yield would be obtained. Similar explanation was reported by Togun and Akanlai (2003). Also, Abo El-Kasem (2006) under similar conditions of this study found that application of chicken manure (10 m^3/fad.)+ pressed olive cake (10 m^3/ fad.) with NFB resulted in increasing yield and its components of tomato plants.

It is obvious that the highest value of TSS was recorded with application of 17.1 ton. of compost (120kg N/fad.) + mixture of natural mineral ore + NFB in both seasons, followed by17.1ton of compost (120kg N/fad.) + NFB then 5.7 ton of compost (40kg N/fad.)+ 80kg. N/fad., of chemical N fertilizers (Table 7).

Also, significant effects for the applied treatments on fruit content of vitamin C in both seasons were detected. The enhancement effect in quality of tomato fruits (vitamin C). In this concern, many researchers came to similar resulted (Rasool *et al.*, 2008; El-Tantawy, 2009; Hala and Nadia, 2010). The same trend of TSS% and vitamin C were recorded by Abd El-Rahman *et al.* (2001) and Darwesh (2002) on tomato.

Conclusion

It could be concluded that, combined application of compost + mixture of natural mineral ore + NFB gave a positive impact on tomato plant growth substantially improved the yield as well as fruit quality. This effect will greatly help in development of organic farming systems and will considerably reduce environmental hazard due to high dependence on chemical fertilizer.

Table 7. Effect of organic, bio- fertilizer and mixture of natural mineral ore on fruit yield and its quality(TSS and Vitamin C) of tomato plant during 2014 and 2015 seasons

Treatment \ Character	Average fruit weight (g)	Fruit number/ plant	Yield /plant (Kg)	Early yield/plant (kg)	Total yield/fad. (ton)	TSS (%)	Vitamine C (mg/ 100g fruit)
				Season (2014)			
T_1	83.17 b	44.67 c	3.580 b	3.927 c	23.61 c	.40 b b b	24.27 b
T_2	67.67 f	34.00 f	2.018 f	1.970 f	13.07 g	3.63 d	21.37 e
T_3	78.17 cd	41.00 de	3.031 d	3.227 d	19.89 e	4.03 c	23.77 bcd
T_4	74.67 e	39.23 e	2.742 e	3.013 e	18.09 f	3.73 d	23.13 d
T_5	81.00 bc	41.20 d	3.316 c	3.797 c	22.03 d	4.63 b	24.23 bc
T_6	76.00 de	41.10 de	3.056 d	3.323 d	20.12 e	4.03 c	23.53 bcd
T_7	83.17 b	46.60 b	1.734 b	4.743 b	25.28 b	4.93 a	24.07 bc
T_8	80.50 bc	42.50 d	3.201 cd	3.853 c	21.46 d	4.40 b	23.50 cd
T_9	89.17 a	49.93 a	4.170 a	5.337 a	28.27 a	5.16 a	25.07 a
				Season (2015)			
T_1	82.67 b	45.03 c	3.550 c	4.043 c	23.57 c	4.26 bc	24.03 b
T_2	68.33 f	33.30 f	2.016 f	2.410 g	13.49 g	3.56 f	20.37 f
T_3	79.50 cd	42.87 d	3.076 e	3.677 de	20.54 e	3.86 e	23.30 c
T_4	76.50 e	40.63 e	2.934 e	3.290 f	19.43 f	3.80 ef	21.70 e
T_5	80.00 c	43.43 cd	3.376 cd	3.873 cd	22.44 d	4.13 cd	24.03 b
T_6	77.67 de	40.67 e	2.945 e	3.440 ef	19.63 ef	3.93 de	22.53 d
T_7	82.67 b	47.30 b	3.844 b	4.543 b	25.68 b	4.46 b	24.43 b
T_8	80.17 c	43.70 cd	3.314 d	3.993 cd	22.23 d	4.00 de	22.73 cd
T_9	89.67 a	51.83 a	4.332 a	5.640 a	29.46 a	4.90 a	25.27 a

* Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of probability.

T1= 5.7 ton compost/ fad. (40 kg N) + 80kg N/ fad., from ammonium sulfate (20.5% N) as control, T2= 11.4 ton of compost/fad. (80kg N), T3= 17.1 ton of compost/fad. (120kg N), T4= 11.4 ton of compost/fad. (80kg N) + 1 ton mixture of natural mineral ore /fad., T5= 17.1 ton of compost/fad. (120kg N) + 1 ton mixture of natural mineral ore /fad., T6= 11.4 ton of compost/fad. (80kg N) + 400 g/ fad., nitrogen fixing bacteria (NFB), T7= 17.1 ton of compost/fad. (120kg N) + NFB, T8= 11.4 ton of compost/fad. (80kg N) + 1 ton/fad., mixture of natural mineral ore + NFB, T9= 17.1 ton of compost/fad. (120kg N) + 1 ton/fad., mixture of natural mineral ore + NFB.

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تأثير الأسمدة العضوية والحيوية ومخلوط المعادن الطبيعية الخام علي المحصول وجودتة فى الطماطم تحت ظروف شمال سيناء

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أجريت تجربة حقلية في صيف موسمي ٢٠١٤ و ٢٠١٥ في المزرعة التجريبية بكلية العلوم الزراعية البيئية بالعريش، جامعة قناة السويس، تهدف التجربة إلى دراسة تأثير الأسمدة العضوية (الكمبوست)، والأسمدة الحيوية، ومخلوط المعادن الطبيعية الخام على إنتاجية وجودة ثمار الطماطم (الهجين المحلي "أليسا")، تحت ظروف التربة الرملية باستخدام نظام الري بالتنقيط، اشتملت التجربة على تسع معاملات وهي: (١): ٥.٧طن/ فدان من الكمبوست (٤٠ كجم ن) +٨٠ كجم نيتروجين / فدان من الأسمدة الكيميائية (سلفات أمونيوم ٢٠.٥% ن)، (٢): ١١.٤طن/ فدان من الكمبوست (٨٠ كجم نيتروجين/ فدان)، (٣): ١٧.١طن/ فدان من الكمبوست (١٢٠ كجم نيتروجين/ فدان) و(٤): ١١.٤ طن/فدان من الكمبوست (٨٠ كجم نيتروجين/ فدان) + ومخلوط المعادن الطبيعية الخام و(٥): ١٧.١ طن/ فدان من الكمبوست (١٢٠ كجم نيتروجين/ فدان)+ ومخلوط المعادن الطبيعية الخام و(٦): ١١.٤ طن/ فدان من الكمبوست (٨٠ كجم نيتروجين/ فدان) + البكتريا المثبتة للنيتروجين و(٧): ١٧.١ طن/فدان من الكمبوست (١٢٠ كجم نيتروجين/فدان) + البكتريا المثبتة للنيتروجين و (٨): ١١.٤ طن/ فدان من الكمبوست (٨٠ كجم نيتروجين/ فدان) + ومخلوط المعادن الطبيعية الخام + البكتريا المثبتة للنيتروجين و(٩): ١٧.١ طن/ فدان من الكمبوست (١٢٠ كجم نيتروجين/ فدان)+ مخلوط المعادن الطبيعية الخام والبكتريا المثبتة للنيتروجين، كما أدى استخدام ١٧.١ طن/فدان من الكمبوست (١٢٠ كجم نيتروجين/ فدان)+ ومخلوط المعادن الطبيعية الخام البكتريا المثبتة للنيتروجين إلى الحصول على أعلى القيم من الوزن الطازج والجاف وكذلك المساحة الورقية، وصبغات التمثيل الضوئي والمحصول المبكر والكلى وكذلك جودة الثمار.

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