ISSN 2320-5407 International Journal of Advanced Research (2015), Volume 3, Issue 10 , 1799 – 1805

ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

((Effect of organic and bio-fertilization on tomato production))

Gmaa, S.S.

Department of Plant Production, Desert Research Center, Matariya, Cairo, Egypt.

Manuscript Info

Manuscript History:

Received: 18 August 2015
Final Accepted: 22 September 2015
Published Online: October 2015

Key words:

Tomato, organic fertilizer, biofertilizers, phosphorin, nitrobin and potassumage

Corresponding Author

Gmaa, S.S.

Abstract

An experiment was conducted at Siwa oasis research station, Desert Research Center (Khimisa Farm) during two consecutive seasons of 2013 and 2014, to evaluate the effect of some agricultural friendly treatments included application of biofertilizers (nitrobin, phosphorin and potassumage) and natural materials as a source of phosphorus and potassium on tomato productivity as compared with conventional treatment. The results showed that, conventional treatment significantly increased growth characters, yield and its component compared with all other treatments in both seasons. However, nitrobin biofertilizer enhanced tomato growth characters, ie., plant height, leaves number, plant fresh weight especially when combined with phosphorin and potassumage as compared with control or without biofertilizer treatments. Also, biofertilzers treatments involved nitrobin (T_5) alone or combined with phosphorin and potasumage (T_7,T_9 T_{10} and T_{11}) enhanced tomato yield per plant compared with control (T_3) or without biofertilizers (T_2) , phosphorin alone (T_4), potassumage alone (T_6) and phosphorin + potassumage (T_8) in both seasons. Increasing tomato yield as a percent to conventional treatment (T_1) were (67.8, 65.5, 62.7, 68.1, 60.8, 69.5, 63.3, 73.7, 72.8, 79.6) and (68.8, 64.9, 71.0, 76.8, 68.0, 77.9, 70.7, 80.9, 82.9, 84.0) for (T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10} and T_{11}) on two seasons respectively.

INTRODUCTION

Tomato (*Lycopersicon esculentum* M) is one of the most important vegetable crops grown throughout the world and ranks next to potato in terms of the area but ranks first as a processing crop. According to the last estimates from the Egyptian Ministry of Agriculture and Land Reclamation in 2013, the tomato acreage increased to 16.636 tons/feddan with a total yield of 8,571,050 tons from a total area of 515,225 feddan **(Ibrahim, 2015).**

The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable food production. The cost of inorganic fertilizers is increasing enormously to an extent that they are out of reach of small and marginal farmers. The problems associated with the use of hazardous chemicals for crop protection, weed control and soil fertility are receiving increasing attention worldwide since pests, diseases and weeds become resistant to chemical pesticides and environmental pollution and ecological imbalances may occur. So, the production of organic agriculture products without inputs of chemical pesticides and synthetic fertilizers has become more concerned **(Abou-Hussein, 2001; Ferrari *et al.*, 2008; Gomaa, 2008)**.

Using of organic fertilizers especially in composted form had positive effect on soil health and fertility, which consequents increased yield in long term **(Mehdizadeh, 2013)**, increased cation exchange capacity of soil and allowing to increase some nutrients such Ca, Mg and P **(Abou-Hussein *et al.*, 2002)**, percent C and total P increased by 2 to 5 fold and K increased from 6 to 12 fold **(Baysal *et al.*, 2008)**, increased leaf gas exchange parameters and pigment content **(Zlatev, 2013).** Also the use of this organic fertilizers results in higher growth, yield and quality of crops since the organic fertilizers contain macro nutrients, essential micro nutrients, many vitamins, growth promoting factors like IAA, GA and beneficial microorganisms **(Mehdizadeh, 2013; Natarjan, 2007; Sreenivasa *et al.*, 2010).** On other hand, some researchers reported that, organic fertilizers may inhibit plant growth and nutrient uptake, which may be attributed to the presence of phytotoxins produced by some species of micro-organisms activated by application of organic fertilizers **(Alvarez *et al.*, 1995),** lake of No_3 concentration around the plant root which lead to less lateral root number and inhibit root hair elongation, which resulted in weak root system **(Mantelin and Touraine, 2004)**.

Environment friendly technologies such as biofertilizers reduces not only the load of chemical fertilizers in crop production but also minimizes the pollution by excessive uses of the latter **(Abul Hossain, 2012)**, increased the number of soil microorganisms, while application of chemicals can be harm to the microorganisms **(Khan *et al.*, 2000; Bareisis *et al.*, 2002)**. Also many researchers found that, comparison with conventional fertilizer the tomato organic farming, produced lower level of TSS, sugars and vitamin C (**Kapoulas *et al.*, 2011)**, lower yields **(Ghorbani *et al.*, 2006; Riahi *et al.*, 2009)**, greater concentrations of P, K, **(Reeve and Drost, 2012 and Ilic *et al.*, 2013)**, lower content of TSS, Zn, Fe and Cu **(Ilic *et al.*, 2013)**, significantly greater of soil quality as measured by total carbon C and N and microbial activity **(Reeve and Drost, 2012).** However, **(Unlu *et al.*, 2011; Kochakinezhad, *et al.*, 2012; Reeve and Drost, 2012)** found that, The difference between the two classes of fertilizers (organic and chemical) was not very high so that, organic fertilizers are competitive and may be a suitable replacement for chemical fertilizers.

Fawzy *et al.*,(2012) on pepper plants found that, using biofertilizers Microbin and Biogen significantly increased the vegetative growth characters (plant length, number of leaves and stems per plant), highest values of fruits physical properties (length, diameter and flesh thickness), increased chlorophyll content of leaves, total amount of N, P and K percentage of leaves and increased chemical properties (T.S.S, Acidity, Ascorbic acid and Carotenoids) of fruits. **Molla *et al.*,(2012)** on tomatoes found that, vegetative growth, such as plant height, number of leaves and branches per plant was significantly influenced by the application of biofertilizers alone or in combination with NPK.

Because tomato is one of the most popular and versatile vegetables in the world, and organic production with a high yield and desirable quality is a target of many producers **(Kochakinezhad *et al.*, 2012)**.The scarcity of fertilizers that are allowed in organic agriculture (AO) encourages the search for alternatives, **(Hernandez *et al.*, 2013)** so the objective of tis study was to find biological alternatives that allow intervening positively on tomato nutrition, production and quality under Siwa oasis conditions.

Material and Methods

Location and experiment design

An experiment was conducted at (Khimisa Farm) Siwa oasis research station, Desert Research Center during two consecutive autumn seasons of 2013 and 2014.The GPS (Global Positioning System) of experimental site is at 29.12_N latitude and 25.29_E longitude with an elevation of 18 meter below the mean seal level. The experimental design was randomized complete block for 11 treatments with 3 replicates. The tomato transplants (Adoura cultivar were cultivated in rows 2 meter width, 30 cm apart under drip irrigation system. The plot area was 10.5 meters. The physical and chemical properties of experimental soil are presented in Table (1 and 2) and the analysis of chicken manure used in this experiment is shown in Table (3).

Treatments

T_1- The recommended dose of organic and chemical fertilizers, i.e., 120 kg N as organic fertilizer + 50 kg P_2O_5 + 75 kg K_2O as minerals fertilizers (Conventional treatment).
T_2- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers.
T_3- Control treatment (without fertilizer)
T_4- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + phosphorin
T_5- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + nitrobin
T_6- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + potassiumag
T_7- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + phosphorin + nitrobin
T_8- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + phosphorin + potassiumag
T_9- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + nitrobin + potassiumag
T_{10}- phosphorin + nitrobin + potassiumag
T_{11}- 50 kg P_2O_5 + 75 kg K_2O as natural fertilizers + phosphorin + nitroben + potassiumag.

All treatments received 120 kg nitrogen as chicken manure calculated as a nitrogen percent in chicken manure used. Natural fertilizers namely rock phosphate (15.5% P_2O_5) and rock potassium (10% K_2O) were used as alternative source of phosphorus and potassium except first treatment since, calcium superphosphate, ammonium sulphate and potassium sulphate were applied.

Three commercial bio-fertilizers were purchased from the Genaral Authority of Agricultural Funds and Equalization, namely Nitroben (non symbiotic nitrogen fixing bacteria), phosphorin (phosphate solubilizing bacteria) and potassiumage (potassium solubilizing bacteria) were added at rates 1500 g/ feddan before planting.

Data recorded:

Vegetative growth:

Random sample of 5 plants of each experimental plot were taken at 60 days after transplanting for vegetative growth data. Plant height, leaves and branch number per plant, and plant fresh and dry weight were recorded. A portable chlorophyll meter (SPAD–502, Konica Minolta Sensing, Inc., Japan) was used to measure leaf greenness of the plants. At 60 days after transplanting, measurements were taken at four locations on each leaf; two on each side of the midrib on the youngest fully expanded leaves of randomly selected five plants per plot and then averaged.

Mineral analysis of leaves:

Leaf samples were taken at 60 days from planting and oven-dried at 65 C$^{\circ}$ until constant weight and ground to pass a 1 mm sieve then 0.1 g of the dry samples was taken and digested using a mixture of sulphuric acid and hydrogen peroxide as described by **Thomas *et al*.,(1976)**. All the studied elements were assayed in the digest of the concerned plant samples. Total nitrogen was determined using Kjeldahl method as described by **Piper, (1945)**. Phosphorus content was measured spectrophotometrically using the ascorbic acid method as described as **(A.O.A.C., 2005)**. Potassium was measured by flame photometer as described by **Page *et al*., (1982).**

Dry matter content:

Plants samples were drayed at 65 C^{o} until constant weight then shoots dry matter content was determined.

Yield components:

Marketable fruits were harvested 3 times during the growing season, counted, and weighed to record fruits number per plant, average fruit weight, total yield per plant and total yield per feddan were calculated.

Fruit quality:

Ten full tomato fruits were collected randomly from each treatment at harvest as subsamples for fruit quality. Toatal soluble solids (TSS) were determined using a hand refractomer and L. ascorbic acid content was determined according to **A.O.A.C.(2005)**

Statistical analysis:

Data were subjected to statistical analysis by M-STAT C **(Russel, 1991)**. The differences among means were performed using least significant difference (LSD) at 5% level.

Table (1) physical analysis of soil experimental site.

Depth (cm)	Particle size distribution (%)				Texture class
	Coarse sand	Fine sand	Silt	clay	
0 - 30	46.8	28.2	15.4	9.6	Medium to fine sand soil
30 - 60	50.0	25.9	18.0	6.1	

Table (2) chemical analysis of soil experimental site.

Depth (cm)	ph	Ec (ds/m)	O.M%	Saturation soluble extract							
				Soluble anions (meq/L)				Soluble cations (meq/L)			
				$Co3^{--}$	Hco_3^{-}	So_4^{--}	cl^{-}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}
0 - 30	7.4	2.3	-	-	4.3	1.4	3.7	4.4	1.3	2.9	0.3
30 - 60	7.8	3.7	-	-	4.9	1.5	2.4	4.8	1.8	2.3	0.4

Table (3): analysis of chicken manure used in both seasons.

season	C%	O.M%	C/N ratio	Macro Elements %					Micro Elements	
				N %	P%	K%	Ca%	Mg%	Fe%	Mn ppm
2013	17.37	35.82	6.09	2.85	0.36	2.23	1.18	0.64	0.12	324
2014	18.22	36.41	6.20	2.94	0.28	1.96	0.88	0.72	0.16	402

Results and discussion

Vegetative growth

Vegetative growth, such as plant height, branches number, leaves number, plant fresh weight and total leaf chlorophyll content were significantly influenced by the application of biofertilizers treatments in addition of conventional treatment in both seasons except branches number in the second season was not significant (Table 4 and 5). Conventional treatment (T_1) offered significantly higher plant height, leaves number, plant fresh weight and leaves chlorophyll content compared with other treatments in both seasons, followed by nitrobin biofertilizer treatments (T_5,T_7,T_9,T_{10} and T_{11}) which gave the moderate values especially when combined with other biofertilizers phosphorin and potassiumage (T_{10} and T_{11}). However, the lowest plant height, leaves number, plant fresh weight and leaves chlorophyll content were recorded in control, without biofertilizers or application of phosphorin or potassiumage biofertilizer treatments (T_2,T_3,T_4,T_6 and T_8) in both seasons. Branches number slightly enhanced by conventional treatment (T_1) or biofertilizer with nitobin especially when added with other biofertilizers phosphorin and potassiomag (T_9,T_{10} and T_{11}) in the first season, while in the second season did not affected significantly with any treatment. On the contrary, control treatment, without biofertilizer and biofertilizer application with phosphorin or potassiomage treatments (T_2, T_3, T_4, T_6 and T_8) produced highest shoot dry matter percent compared with other treatments especially the conventional treatment (T_1) which produced the lowest value in both seasons.

Enhancing growth response of pepper (**Fawzy *et al*., 2012),** potato **(Abou-Hussein, 2001; and Gomaa, 2008)** and tomato (**Kochakinezhad *et al*., 2012; Molla, *et al*., 2012; Hernandez *et al*., 2013)** were noticed by the application of biofertilizers. Increasing plant growth by biofertlizers may be due to increasing number of soil microorganisms living in the soil which working on the organic matter to convert organic form of nutrients such as N to mineral N. Also microorganisms in turn release chemicals which may affect plant growth and organic acids which are needed to break down soil mineral fertilizer and make nutrients such as phosphate available to the plant, while application of chemicals can be harm to the microorganisms **(Khan *et al*., 2000; Bareisis *et al*., 2002)**, significantly greater of soil quality as measured by total carbon C and N and microbial activity **(Reeve and Drost, 2012).** Also, tomato take up large amounts of nutrients depend on the quantity of fruit and dry matter they produce, which in turn is influenced by a number of genetic and environmental variables. In the absence of other production constraints, nutrient uptake and yield are very closely related **(Hegde, 1997).** So, the superiority of conventional treatment for vegetative growth is noticed in our study compared with biofertilizers treatments especially in the absence of nitrobin (nitrogen fixing bacteria) application which may be ensure some of nitrogen requirements for tomato plants, while other biofertilizer treatments phosphorin or potassumage had not the same action.

Table 4: effect of organic and biofertilizers application on plant height, branch number and leaves number of tomato.

Character	plant height (cm)		branch number		Leaves number	
Treatments	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**
T_1 (NPK (120-50-75) as mineral)	73.88	78.60	7.48	6.40	35.29	40.03
T_2(PK(50-75) as rocks	53.66	52.21	5.91	5.99	23.97	26.77
T_3(control)	55.21	52.42	5.73	5.24	22.94	26.88
T_4(PK(50-75) as rocks + phosphorin)	57.22	55.80	6.00	6.06	23.33	27.90
T_5(PK(50 ,75) as rocks + nitobin)	60.35	61.28	6.35	6.05	23.75	31.97
T_6(PK(50,75) as rocks+potassiumge)	54.75	54.11	6.00	5.82	23.33	27.06
T_7(PK(50-75) as rocks+ phosphorin+nitrobin)	60.53	61.31	6.52	6.29	24.45	31.99
T_8(PK(50-75) as rocks+phosphorin+potassiumage)	56.40	52.33	6.00	6.07	22.66	26.16
T_9(PK(50-75) as rocks+nitrobin+potassiumage)	61.75	63.66	6.64	6.53	25.48	33.50
T_{10}(phosphorin +nitrobin+potassiumage)	61.65	65.24	6.88	6.36	27.52	32.62
T_{11}(PK(50-75) as rocks+posphorin+nitrobin+potassiumage)	63.55	66.69	7.14	6.45	28.92	34.34
L.S.D	**4.77**	**2.6**	**0.59**	**NS**	**3.01**	**2.54**

Table 5: effect of organic and biofertilizers application on plant fresh weight, total chlorophyll percent and shoot dry matter percent of tomato.

Character	Plant fresh weight (g)		chlorophyll %(SPAD)		shoots dry matter %	
Treatments	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**
T_1 (NPK (120-50-75) as mineral)	1499.6	1531.4	53.00	53.77	29.6	32.7
T_2(PK(50-75) as rocks	1004.7	1057.5	46.03	47.61	38.4	36.7
T_3(control)	974.7	1055.3	44.99	47.08	38.7	37.7
T_4(PK(50-75) as rocks + phosphorin)	967.5	1117.0	46.55	50.23	39.0	37.7
T_5(PK(50 ,75) as rocks + nitobin)	1114.7	1181.9	48.63	50.99	33.9	34.6
T_6(PK(50,75) as rocks+potassiumge)	1019.7	1074.5	45.80	48.65	38.7	37.7
T_7(PK(50-75) as rocks+ phosphorin+nitrobin)	1109.7	1194.5	49.67	51.23	34.7	35.0
T_8(PK(50-75) as rocks+phosphorin+potassiumage)	1003.3	1059.4	46.89	48.13	38.5	38.5
T_9(PK(50-75) as rocks+nitrobin+potassiumage)	1139.7	1240.4	49.72	49.81	35.5	36.2
T_{10}(phosphorin +nitrobin+potassiumage)	1169.7	1271.1	50.45	50.19	34.9	35.5
T_{11}(PK(50-75) as rocks+posphorin+nitrobin+potassiumage)	1214.7	1286.4	50.19	50.72	35.6	35.3
L.S.D	**74.48**	**90.31**	**1.12**	**2.64**	**1.72**	**2.19**

Yield and its component

Tomato yield, average fruits number per plant and average fruit weight were significantly enhanced by biofertilizers treatments and conventional treatment as compared with control or without biofertilizer treatment in both seasons, Table (6). Conventional treatment (T_1) produced the highest fruits number, heaviest fruit weight and highest yield per plant, followed by biofertilizer treatments which included nitrobin preparation combined with other biofertilizers (T_9,T_{10} and T_{11}) in both seasons. The lowest fruit number per plant, average fruit weight and total yield per plant were obtained in control (T_3) and without biofertilizer (T_2) treatments followed by biofertlizer treatments included phosphorin or potassiumge even added sole or together (T_4,T_6 and T_8).

Enhancing fruits number, average fruit weight and total yield per plant by biofertilizers application may be due to that applying biofertilizers increased microorganisms in the soil which converting the ability of mobilizing the unavailable forms of nutrients elements to available forms **(Ishac, 1989)**. Also, the microorganisms produce growth promoting substance, which increase the plant growth which lead to increasing in the photosynthetic rate and leading to an increase of the assimilation rates and consequently increasing total yield per plant. Concerning of studied treatments effect on yield per plant as a percent to conventional treatment (T_1) was (67.8, 65.5, 62.7, 68.1, 60.8, 69.5, 63.3, 73.7, 72.8, 79.6) and (68.8, 64.9, 71.0, 76.8, 68.0, 77.9, 70.7, 80.9, 82.9, 84.0) for (T_2, T_3, T_4,T_5, T_6, T_7, T_8, T_9, T_{10} and T_{11}) in two seasons respectively. Generally, 20 – 30 percent decrease in yield is expected in plants cultivated with organic and biofertilizers treatments compared with conventionally treatment, this results are in agreement with **(Ghorbani *et al*., 2006; Riahi, *et al*., 2009).** However, **(Unlu, *et al*., 2011; Kochakinezhad, *et al*., 2012; Reeve and Drost, 2012)**found that the difference between the two classes of fertilizers (organic and chemical) was not very high so that, organic fertilizers are competitive and may be a suitable replacement for chemical fertilizer.

Table 6: Effect of organic and biofertilizers application on average fruit number, average fruit weight (g) and total yield (kg /plant) of tomato.

Character	average fruit number		average fruit weight (g)		total yield(kg /plant	
Treatments	2013	2014	2013	2014	2013	2014
T_1 (NPK (120-50-75) as mineral)	34.53	38.12	103.78	95.25	3.57	3.62
T_2(PK(50-75) as rocks)	27.48	32.95	88.26	75.90	2.42	2.49
T_3(control)	27.17	30.91	86.26	76.83	2.34	2.35
T_4(PK(50-75) as rocks + phosphorin)	27.15	31.12	83.67	82.60	2.24	2.57
T_5(PK(50 ,75) as rocks + nitobin)	29.15	32.59	83.69	85.26	2.43	2.78
T_6(PK(50,75) as rocks+potassiumge)	27.20	30.01	80.08	82.02	2.17	2.46
T_7(PK(50-75) as rocks+ phosphorin+nitrobin)	29.82	33.69	83.66	83.81	2.48	2.82
T_8(PK(50-75) as rocks+phosphorin+potassiumage)	27.13	32.65	83.73	78.50	2.26	2.56
T_9(PK(50-75) as rocks+nitrobin+potassiumage)	30.25	34.80	87.98	84.27	2.63	2.93
T_{10}(phosphorin +nitrobin+potassiumage)	31.17	35.53	83.75	84.57	2.60	3.00
T_{11}(PK(50-75) as rocks+posphorin+nitrobin+potassiumage)	32.51	35.90	88.32	84.71	2.84	3.04
L.S.D	**1.38**	**2.83**	**11.55**	**10.26**	**0.33**	**0.16**

Fruit quality and shoot mineral content

Data presented in Table (7) showed that conventional treatment (T_1) increased fruit TSS and L ascorbic acid content as compared with other treatments. Biofertilizers application with nitrobin or potassumage and his combination (T_5, T_6, T_8, T_9,T_{10} and T_{11}) slightly enhanced TSS content of tomato fruits as compared with other biofertilizer application. However, application of nitrobin with other biofertilizers (T_9, T_{10} and T_{11}) produced the highest fruit content of L ascorbic acid after conventional treatment (T_1), while control and without biofertilizer treatments (T_2 and T_3) produced the lowest value in this respect.

Table 7: Effect of organic and biofertilizers application on tomato fruits TSS, L ascorbic acid content and tomato shoot NPK content.

Character	tomato fruits content		tomato shoot content		
Treatments	**TSS**	**L ascorbic acid**	**N %**	**P%**	**K%**
T_1 (NPK (120-50-75) as mineral)	9.02	20.79	3.72	0.34	4.37
T_2(PK(50-75) as rocks	6.04	13.93	2.49	0.23	2.93
T_3(control)	5.86	13.51	2.42	0.22	2.84
T_4(PK(50-75) as rocks + phosphorin)	6.13	14.14	2.28	0.28	2.97
T_5(PK(50 ,75) as rocks + nitobin)	7.82	14.97	2.68	0.24	3.15
T_6(PK(50,75) as rocks+potassiumge)	7.82	15.05	2.32	0.23	3.54
T_7(PK(50-75) as rocks+ phosphorin+nitrobin)	6.67	15.38	2.75	0.27	2.90
T_8(PK(50-75) as rocks+phosphorin+potassiumage)	7.14	14.14	2.53	0.27	3.27
T_9(PK(50-75) as rocks+nitrobin+potassiumage)	7.85	15.80	2.83	0.26	3.32
T_{10}(phosphorin +nitrobin+potassiumage)	7.70	16.22	2.80	0.27	3.41
T_{11}(PK(50-75) as rocks+posphorin+nitrobin+potassiumage)	7.97	16.84	2.70	0.28	3.46
L.S.D	**0.79**	**0.39**	**0.22**	**0.03**	**0.43**

Concerning, tomato shoot NPK content, the conventional treatment showed the highest shoot NPK content compared with other treatments. Biofertilizer application with nitrobin preparation enhanced shoot NPK contents especially when added with phosphorin and potassumage (T_9, T_{10} and T_{11}), while phosphorin and potassumage application (T_4 and T_6) enhanced only phosphorus and potassium shoot content respectively. On the other hand, control and without biofertilizer treatments (T_3 and T_2) significantly reduced the tomato shoot content of NPK.

References

Abou-Hussein, S.D., 2001. Studies on potato production under organic-farming conditions. Ph.D.Thesis, Fac. of Agric., Ain Shams Univ., Cairo, Egypt.

Abou-Hussein, S. D.; I. El-Oksh; T. El-Shorbagy and U. A. El-Bahiry, 2002. Effect of chicken manure, compost and biofertilizers on vegetative growth, tuber characteristics and yield of potato crop. Egypt. J.hort. 29,(1) 135-149.

Abul Hossain, M.; M. M. Haque; M. A. Haque and G. N. M. Ilias, 2012. Trichoderma-Enriched Biofertilizer Enhances Production and Nutritional Quality of Tomato (*Lycopersicon esculentum* Mill.) and Minimizes NPK Fertilizer Use. Agric Res 1(3):265–272.

Alvarez, M.A.; E. S. Gagne and H. Antoun, 1995. Effect of compost on ryzosphere microflora of the tomato and on the incidence of plant growth-promoting rhizobacteria. Appl. Enviro. Microbiology. 61(1) 194-199.

A.O.A.C. Association of Official Analytical Chemists-International, 2005. Official Methods of Analysis. 18th edn., eds.W. Hortwitz, G. W. Latimer, AOAC-Int. Suite 500, 481 North Frederick Avenue, Gaithersburg, Maryland, USA**.**

Bareisis, R.; P. Sniauka and G. Viselga, 2002. Investigation of ecological potato cultivation possibilities. Progressive eco-frindly technological processes in agricultural engineering. Proceedings of the international conference raudondvaris Lithuania 57 (66):221-222. (C.f. CAB Abstracts 2002-2003).

Baysal, F., M. S. Benitez, M. D. Kleinhenz, S. A. Miller, and B. B. M. Gardener, 2008. Field management effects on damping-off and early season vigor of crops in a transitional organic cropping system. Phytopathology; 98(5):562-570.

Fawzy Z. F., A. M. El-Bassiony, L. Yunsheng, O. Zhu and A.A., Ghoname, 2012. Effect of Mineral, Organic and Bio-N Fertilizers on Growth, Yield and Fruit Quality of Sweet Pepper Journal of Applied Sciences Research, 8(8): 3921-3933.

Ferrari, A. A., E. A. N. Fernandes, F. S. Tagliaferro, M. A. Bacchi, T. C. G. Martins, 2008. Chemical composition of tomato seeds affected by conventional and organic production systems. Journal of Radioanalytical and Nuclear Chemistry; 278(2):399-402.

Ghorbani, R., A. Koocheki, M. Jahan, and G. A. Asadi, 2006. Effects of organic fertilizers and compost extracts on organic tomato production. Aspects of Applied Biology (79):113-116.

Gomaa, S.S., 2008. Effect of organic and bio-fertlization and soil solarization on potato production under north Sinai conditions. Ph.D.Thesis, Fac. of Agric., Ain Shams Univ., Cairo, Egypt.

Hegde, D. M., 1997. Nutrient requirements of solanaceous vegetable crops.1997. Extension Bulletin - ASPAC, Food & Fertilizer Technology Center (441):9 pp.

Hernandez, M., C. Cano-Rios, P. F. Viramontes, U. A. Diaz, J. A. R. Dimas and N. G. Hernandez, 2013. Yield and quality of tomato with organic sources of fertilization under greenhouse conditions. Phyton (Buenos Aires) 82:55-61(c.F. CAB abst. 2013).

Ibrahim,S. S.; F. A. Moharum and N. M. Abd El-Ghany, 2015. The cotton mealybug Phenacoccus solenopsis Tinsley (*Hemiptera: Pseudococcidae*) as a new insect pest on tomato plants in Egypt. J. of p. protect. Res. (55): 125-133.

Ilic, Z. S., N. Kapoulas, and L. Milenkovic, 2013. Micronutrient composition and quality characteristics of tomato (*Lycopersicon esculentum*) from conventional and organic production. Indian Journal of Agricultural Sciences 83(6):651-655.

Ishac, Y.Z., 1989. Inoculation with Associative N2 fixer in egypt. Kluwer academic publishers, 241-246.

Kapoulas, N., Z. S. Ilic, M. urovka, R. Trajkovic, and L. Milenkovic, 2011. Effect of organic and conventional production practices on nutritional value and antioxidant activity of tomatoes. African Journal of Biotechnology 10(71):15938-15945.

Khan, V.A., C. Stevens, M. A. Wilson, J. E. Brown, D. J. Collins, J. Y. Lu, and E. G. Rhoden, 2000. Evidence of rhizobacteria changes associated with the increase growth response of vegetables grown in agrimulch systems. J. of Vegetable Crop Production. 6 (1): 53-73.

Kochakinezhad, H., G. Peyvast, A. K. Kashi, J. A. Olfati, and A. Asadii, 2012. A comparison of organic and chemical fertilizers for tomato production. J. of Orga. Systems. 7(2):14-25.

Mantelin, S. and B. Touraine, 2004. Plant growth promoting bacteria and nitrate availability impacts on root development and nitrate uptake. J. Experi. Botany,55 (394): 27-34.

Marquez-Hernandez, C., P. Cano-Rios, U. Figueroa-Viramontes, J. A. Avila-Diaz, N. Rodriguez-Dimas, and J. L. Garcia-Hernandez, 2013. Yield and quality of tomato with organic sources of fertilization under greenhouse conditions. Phyton (Buenos Aires)(82):55-61.

Mehdizadeh, M., E. I. Darbandi, H. Naseri-Rad, and A. Tobeh, 2013. Growth and yield of tomato (*Lycopersicon esculentum* Mill.) as influenced by different organic fertilizers. International Journal of Agronomy and Plant Production. 4(4):734-738.

Molla, A. ; M. M. Haque; M. A. Haque and G. N. M. Ilias, 2012.Use Trichoderma-Enriched Biofertilizer Enhances Production and Nutritional Quality of Tomato (*Lycopersicon esculentum* Mill.) and Minimizes NPK Fertilizer Use Agric. Res. 1(3):265–272.

Natarajan K, 2007. Panchagavya for plant. Proc. Nation. Conf. Glory Gomatha, Dec. 1-3, S. V. Veterinary Univ., Tirupati, pp. 72-75.

Page, A.L., R.H. Miller and D.R. Keeney,1982. Methods of soil analysis-chemical and microbiology properties, SSSA Inc., Mad., WI., USA.

Piper, C.S., 1950. Soil and plant analysis.1st Ed. Interscience Publishers Inc., New York, USA, pp 30-59**.**

Reeve, J., and D. Drost, 2012. Yields and soil quality under transitional organic high tunnel tomatoes. HortScience. 47(1):38-44.

Riahi, A., C. Hdider, M. Sanaa, N. Tarchoun, M. B. Kheder, and I. Guezal, 2009. Effect of conventional and organic production systems on the yield and quality of field tomato cultivars grown in Tunisia. Journal of the Sci. of Food and Agric. 89(13):2275-2282.

Russell, D. F., 1991. In " MSTATC, Directory crop soil science Department" Michigan Universty.USA.

Sreenivasa M.N, M.N. Nagaraj, and S.N. Bhat, 2010. Beejamruth: A source for beneficial bacteria. Karnataka J. Agric. Sci., 17(3): pp.72-77.

Thomas, R.L., R.W. Sheard and J.R. Moyer, 1976.Comparison of conventional and automated procedures for nitrogen, phosphorus and potassium analysis of plant materials using a single digestion. Agron. J., 59: 240-243.

Unlu, H., H. O. Unlu, Y. Karakurt, and H. Padem, 2011. Influence of organic and conventional production systems on the quality of tomatoes during storage. African Journal of Agricultural Research 6(3):538-544.

Zlatev, Z., and V. Popov, 2013. Effect of organic fertilizers on photosynthesis of young tomato plants (*Lycopersicon esculentum* Mill.) Agricultural Science and Technology. 5(1):35-38.