Growth, Yield and Fruit Quality of Sweet Pepper Plants as Affected by Some BioOrganic and Mineral Fertilizers Application

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Abstract: Two field trials were conducted at the Experimental Farm of the Faculty of Agriculture, Tanta University, Egypt, during the summer growing seasons of 2011 and 2012, to evaluate the effect of some bio organic and mineral fertilizers (compost at 10, 15 and 20 ton/fed., Easternabiofert at 50, 100 and 150 kg/fed. plus recommended dose of organic manure, the mixture of bio-fertilizers (Phosphorein, Potassiumage and Rhizobacterin) combined with 75% of the recommended dose of mineral fertilizers and farmyard manure and 100 % of recommended dose of mineral fertilizers plus farmyard manure) on growth, flowering, yield and fruit quality of sweet pepper plants cv. California Wonder. The obtained results indicated that, the application of the three treatments; (the first was recommended dose of NPK plus farmyard manure, the second was 75% recommended dose plus Phosphorein, Potassiumage and Rhizobacterin the third treatment was Easternabiofert at 150 Kg/fed plus recommended dose of organic manure,) followed by compost at 20 ton/fed., significantly increased plant height, number of branches per plant, number of leaves per plant, fresh and dry weight of whole plant, photosynthetic pigments i.e. chlorophyll a, b and carotenoids, Endogenous phytohormones i.e. auxins, gibberellins and cytokinins, fruit weight, number of fruits per plant, dry weight of fruit and early and total fruit yield. Also, significant effects were obtained for N% and P% in the leaves as well as Vitamin C, N % and P % in the fruits in both seasons. There were no significant differences between these treatments and the complete recommended dose of NPK mineral fertilizers in this concern. Different Bio organic treatments resulted in the lowest values of nitrate in fruits, in the two growing seasons. The application of 75% recommended dose of NPK and organic manure plus the mixture of bio-fertilizers (phosphorein, potassiumage and rhizobacterin) or Easternabiofert at 150 Kg/fed plus recommended dose of organic manure can be used in sweet pepper production without reducing the productivity and quality. These bio organic fertilizers treatments will reduce the cost of chemical fertilizers, avoid the risk of nitrate accumulation in the edible portions and decrease the pollution of the environment. Also, applying the compost at 20 ton/fed. leads to lower productivity compared to the full dose of mineral fertilizers, but the yield will be higher in price, achieving more profit for producers.

[Mohammed. E. M. Ahmed, Amany A. Abd-Ellatifand Asem A. Al-Araby. **Growth, Yield and Fruit Quality of Sweet Pepper Plants as Affected by Some BioOrganic and Mineral Fertilizers Application.** *Life Sci J* 2013;10(4):2756-2766]. (ISSN:1097-8135). http://www.lifesciencesite.com. 369

Keywords: Sweet pepper, bioorganic, mineral fertilizers, Vegetative growth, Fruit yield, chemical contents

1. Introduction

Sweet pepper (*Capsicum annuum* L.) is one of most popular and favorite vegetable crops cultivated in Egypt for local market and exportation. High cash crops such as sweet pepper have occupied an important rank in Egyptian and world agriculture due to its high profit and nutritional values for human health. Green fruits contain chlorophyll A and chlorophyll B **(Rajput and Poruleker, 1998).**

Fertilization is one of the major factors affecting the growth, and yield of sweet pepper. However, the chemical fertilizers represent the major costof plant production. In addition, the excessive use of chemical fertilizers creates pollution of agro-ecosystem aswell as deterioration of soil fertility (**Lyons *et al.,* 1994**).

In order to improve the use of chemical fertilizers and to reduce the environmental pollution in agriculture, some integrated management strategies have been developed. There is further potential to optimizerate of chemical fertilizers to meet the actual requirements of the plants thus, reduce chemical fertilizerssubstantially (**Singh, *et al.,* 2007** and **Hassan, *et al.,* 2012).**

Recently, it has become essential to use nontraditional fertilizers. It is well known that a considerable number of bacterial species, mostly those associated with the plant rhizospher, areable to exert a beneficial effect upon plant growth. Therefore, their use as bio-fertilizers or control agents for agricultural improvement has been a focus of numerous researchers for a number of years. The utilization of organic and bio-fertilizers is considered today by many scientists as a promising alternative particularly indevelopingcountries (**Rodriguez and Fraga, 1999** and **Hassan, *et al.,* 2012).**

There is a great debate among scientists about the role of the microorganisms in promoting plant growth. Some investigators stressed their contribution to N_2-fixation, P or K solubilization and cellulose decomposition, while others stressed to the production of plant growth modifying substances by such bio-fertilizers. Soil microorganisms, known as phosphate solubilizing bacteria, play a fundamental role in correcting the solubility problems in different soils, by releasing the fixed form of P to soluble one to be ready for plant nutrition. The organisms capable of carrying out such process are known as phosphate dissolvers (**El-Shaikh, 2005;Hassan, *et al.,* 2012; and Rodriguez and Fraga, 1999**).

Phosphorein, potassiumage, rhizobacterin and Easternabiofertare commercial bio-fertilizers which gave the same effect of full dose of mineral nitrogen application (**Tawfik, 2008**).Phosphorein partially overcomes the phosphate fixation problem in calcareous soil as found by **Han and Lee (2005)**.

Easternabiofert has the ability to release macro and micro nutrients gradually and supply the crop throughout the vegetation periods (**Adediran*et al.,* 2004**). Therefore, it caused a significant increase in growth parameters and yield components compared to NPK fertilizers (**El-Gamal and Hammad, 2005**). Rhizobacterin also has high amount of symbiotic and non symbiotic bacteria responsible for atmospheric nitrogen fixation.

Compost enhances the environmental sustainability of agriculture by decreasing chemical inputs and increasing the amount and quality of soil organic matter (**Mathur *et al.,* 1993**, **Rivero *et al.,* 2004 and Shehata, 2012**), stimulating soil microbial activity (**Garcia *et al.,* 1994 and Pascual*et al.,*1997**). When compost applied to soil, not only degradable substrates and nutrients aresupplied, but also a wide range of microorganisms (**Ryckeboer *et al.,* 2003**),

Therefore, the aim of this study was to investigate the effect of some commercial organic and bio-fertilizers i.e. compost, sternabiofert and the mixture of Phosphorein, Potassiumage and Rhizobacterin with different levels of NPK fertilizers on the growth, yield components and quality of sweet pepper plants compared with the recommended dose of mineral fertilizers.

2. Material and Methods

This investigation was carried out at the Experimental farm of Faculty of Agriculture, Tanta University, Tanta, Egypt, during the two successive summer seasons of 2011 and 2012. The main aim of the present study was to investigate the effect of some commercial organic and bio-fertilizers i.e. Compost, Easternabiofert with different application rates and the mixture of Phosphorein, Potassiumage and Rhizobacterin with 75% of NPK fertilizers on the growth, yield and yield quality of sweet pepper plants under clay soil. The physical and chemical properties of the experimental soil (**Ryan *et al.,* 1996**)were presented below:

Sand = 16.2 %	N(available) = 42.1 mg/100g	Ca^{++}=6.47 (meql)	HCO_3^- =5.11(meql)
Silt = 40.33 %	P (available) =6.4 mg/100g	Mg^{++}=5.04 (meql)	Cl^- = 8.04(meql)
Clay = 43.48 %	K (available) = 186.2 mg/100g	Na^+ = 12.25 (meql)	SO_4^{--} = 10.0(meql)
pH = 7.59	EC = 1.2 (ds/m)	-----------	

Plant material:

Sweet Pepper seeds(*Capsicum annuum*, L., cv. California Wonder) were sown in the nursery under low plastic tunnelson 16th and 17 January 2011 and 2012 seasons, respectively, and transplanted in the open field on 6th and 8th of March in the two growing seasons, respectively at 30 cm apart in one side of the ridges. (4 m in length and 70 cm in width).

Field experimental layout:

Easternabiofert was used at the rate of 50, 100 and 150 kg/fed and added, as a basal dressing, to the plant in two equal doses. The first one was after thinning and the second was at flowering according to the manufacturer's recommendations.

Plant compost "El-Nile Compost Company" was used at the rate of 10, 15 and 20 m3/fed. and added, as a basal dressing, to the plant in one dose. Analysis of compost was as follows:

PH	8.0	Total phosphorus (%)	0.70
Ec (ds/m)	2.05	Total potassium (%)	1.2
Organic carbon (%)	31	Iron (ppm)	1700
Organic matter (%)	50	Manganese (ppm)	160
Total Nitrogen (%)	1.8	Copper (ppm)	65
C/N ratio	1 17	Zinc (ppm)	28
Weight of m^3 (kg.)	650	-----------	

Mixture of Phosphorein (a phosphorus biofertelizer containing phosphate dissolvers or vesicular arbuscularmycrohizas and silicate bacteria), Potassiumage and Rhizobacterin (a nitrogenous biofertelizer containing nitrogen fixing bacteria like Azotobacter), with 75 % of the recommended dose of mineral fertilizers. Enriching seedling roots with bio-fertilizers suspension by dissolve the bio-fertilizers in water mixing with Arabic gum with dipping the roots for 3 minutes in the suspension before transplanting. Bio-fertilizers were added at 3 kg/fed according to the recommendation of Ministry of Agriculture.

The recommended dose of NPK and farmyard manure (RD) used was 30 m^3 farmyard manure, 650 kg/fed ammonium sulphate (20.5 % N), 300 kg/fed. calcium super phosphate (15.5 % P_2O_5) and 100 kg/fed potassium sulphate (48 % K_2O) according to the recommendation of Ministry of Agriculture, Egypt. Ammonium sulphate was added as a basal dressing, in four doses (50 kg/fed) was added during soil preparation prior to transplanted, then three equal doses of 200 kg/fed each, was applied at one and two months after transplanting the last dose was applied at 60% flowering),while calcium super phosphate was added in two equal doses, the first was added during soil preparation prior to sowing and the second dose was applied after two months from transplanting and potassium sulphate was added in two equal doses, which were added during soil preparation prior to sowing and at 60% of flowering.

The experiment had eight treatments as follows:

T1: Easternabiofert at 50 Kg/fed. + recommended dose of organic fertilizer (Es 50)

T2: Easternabiofert at 100 Kg/fed. + recommended dose of organic fertilizer (Es 100)

T3: Easternabiofert at 150 Kg/fed. + recommended dose of organic fertilizer (Es 150)

T4: Compost at 10 ton/fed. (Comp 10)

T5: Compost at 15 ton/fed. (Comp 15)

T6: Compost at 20 ton/fed. (Comp 20)

T7: 75%RD+ Phosphorein + Potassiumage + Rhizobacterin (75%RD+Bio)

T8: Recommended dose (RD)of mineral N, P, K and organic fertilizer

All agricultural practices needed for sweet pepper production under open field conditions were followed according to the recommendation of Ministry of Agriculture, Egypt. The experiment layout was randomized complete block design, with three replicates of each treatment.The plot area was 16.8 m^2 which contained 6 rows with 4 m in length and 70 cm in width.

Data recorded*:*

Vegetative traits: five plants of each plot were randomly taken at 90 days after transplanting to measure, plant height (cm), number of branches/ plant, number of leaves/ plant, fresh and dry weight/ plant (g).

Flowering traits: five plants of each plot were randomly chosen, labeled to determine the following parameters; number of days to flowering (days after transplanting), number of flowers per plant and percentage of fruit set.

Yield and fruit quality: All harvested fruits from each plot were used to determinate early marketable yield and total marketable yield. Early marketable yield was determined from the first three harvests. Average fruit weight was calculated from all harvested fruits from each plot during the whole season. Ten representative marketable fruits from each treatment at the middle of harvesting season were collected and used to determine of fruit weight (g), fruit length (cm), fruit diameter (cm), fruit dry weight (%), Fruit wall thickness (cm) and fruits number/ plant.

Chemical composition: Chlorophylls a, b, a+b, Caroteniods, were determined, in the fourth leaf from five plants, at 95 days after transplanting, colorimetrically as described by **Inskeep and Bloom, 1985**. Nitrogen (%), phosphorus (%) and potassium (%) content of leaves and fruits were determined, in the fourth leaf, at 95 days after transplanting and in fruits at harvest according the methods described by **Horneck and Hanson, 1998;Horneck and Miller, 1998;** and **Sandell, 1950;** respectively. Total carbohydrates were determined in fruits according to (**Dubios, *et al.*,1956**). Crude protein was calculated in leaves and fruits according to the following equation: Crude protein (%) = Total nitrogen x 6.25 (**A.O.A.C., 1990**). Total soluble solids (T.S.S.) were measured using a hand refractometer, vitamin C and titratable acidity were determined according to the methods described by the (**A.O.A.C., 1990**).

Endogenous phytohormones were quantitatively determined in sweet pepper shoots at 95 days after transplanting in the second season using High-Performance Liquid Chromatography (HPLC) according to **Koshioka, *et al.*, 1983** for auxin (IAA), gibberellic acid (GA3) and abscisic acid (ABA), while, cytokinins were determined according to (**Nicander *et al.*, 1993**).

Statistical analysis:

Data were subjected to convenient statistical analysis methods for calculations of means, variance and standard error according to MSTATC software program adopted by **Bricker, (1991)**. Mean separations were estimated by calculating LSD (least significant difference) value at 5% level according to **Snedecor and Cochran (1990)**.

3. Results

1- Vegetative growth

Data in Table (1) show that all vegetative growth parameters i.e. plant height, number of leaves/ plant, number of branches/ plant as well as fresh and dry weight of whole plant were significantly affected by bio organic and mineral fertilizers application.The highest values of vegetative growth parameters were recorded using three treatments; the first was recommended dose of NPK and farmyard manure, the second was 75% recommended dose plus Phosphorein, Potassiumage and Rhizobacterin the third treatment was Easternabiofert at 150 Kg/fed. plus recommended dose of organic manure. There were no significant differences between these treatments in both seasons. While, the lowest values were recorded with application of compost at 10 or 15 ton/fed. The stimulatory effect of the best treatments on different estimated characteristics of sweet pepper growth could be attributed to the satisfactory effect of these components upon the photosynthetic pigments and chemical composition (Table 2) and endogenous phytohormones (Table 3). Other investigators recorded similar trends (**Ahmed, 2009** on onion; **Midan and Sorial, 2011** on snap bean; **Hassan *et al.*, 2012** on coriander and **Shehata*et al.*, 2012** on cucumber).

Table 1. Effect of some bio organic and mineral fertilizers on the vegetative growth characters of sweet pepper plants during 2011 and 2012 seasons

Treatments	Plant height (cm)	No. of branches/ plant	Fresh wt. of whole plant (g)	Dry wt. of whole plant (g)	No. of leaves/ plant
First season 2011					
Es 50	56.7±1.2	7.62±0.08	228.4±3.0	36.2±0.3	80.5±0.7
Es 100	60.1±0.8	7.99±0.02	230.7±2.1	37.8±0.7	83.4±0.6
Es 150	64.2±0.9	8.25±0.06	237.9±2.3	39.1±0.4	90.9±1.0
Comp 10	51.3±0.2	7.04±0.03	195.8±1.9	28.9±0.6	70.9±0.6
Comp 15	55.1±0.8	7.55±0.11	201.4±0.7	31.9±0.3	74.5±0.7
Comp 20	60.4±1.4	8.21±0.08	215.1±1.5	33.5±0.4	81.0±0.6
75%RD+Bio	63.9±0.4	09.34±0.03	241.9±0.8	42.1±0.6	92.8±0.9
RD (control)	65.8±1.3	9.24±0.06	239.1±1.0	42.9±0.5	90.5±0.5
L.S.D. at 5%	3.2	1.07	19.6	3.28	4.95
Second season 2012					
Es 50	57.4±0.3	8.83±0.04	230.8±2.3	39.9±0.9	83.7±1.0
Es 100	65.1±0.5	9.52±0.03	237.4±2.3	44.2±0.7	90.2±0.9
Es 150	67.9±0.6	10.07±0.08	245.9±0.8	47.1±0.9	97.4±0.7
Comp 10	53.5±0.4	7.95±0.05	199.7±0.9	32.7±0.6	75.1±0.6
Comp 15	58.1±0.8	8.86±0.06	215.1±1.7	34.1±0.7	78.4±0.9
Comp 20	66.7±0.6	9.94±0.07	221.8±2.3	35.9±0.9	87.6±0.8
75%RD+Bio	69.9±0.9	10.14±0.04	248.5±1.9	47.2±0.4	96.9±0.9
RD (control)	69.2±0.6	10.52±0.06	252.4±2.4	49.6±0.6	99.7±1.0
L.S.D. at 5%	3.9	0.75	11.7	2.87	5.05

Where: **ES** is Easternabiofert at 50,100 and 150 K.g/fed., **Comp**: Compost at 10,15 and 20 tons/fed., **RD**: Recommended dose of mineral NPK, **Bio**: Phosphorein + Potassiumage + Rhizobacterin

2- Photosynthetic Pigments

Data presented in Table (2) clearly indicate that different photosynthetic pigments, chlorophyll a, b and carotenoids, positively responded to the different treatments, during the two assigned seasons. It was observed that, these three treatments (1st; RD of NPK and farmyard manure, 2nd 75% RD plus Phosphorein, Potassiumage and Rhizobacterin and 3rd Easternabiofert at 150 Kg/fed. plus RD of organic manure.) gave the highest increases in chlorophyll a, b and carotenoids. While, the lowest values were recorded with application of compost at 10 or 15 ton/fed. These results were significant in both seasons.

3- Endogenous Phytohormones:

Endogenous phytohormones of sweet pepper leaves as affected by bio organic and mineral fertilizers are shown in Figures (1 and 2). According to these results, all promoters (auxins, gibberellins and cytokinins) were improved by application of all bio organic fertilizers, but, abscisic acid was decreased. Application of (75% RD plus Phosphorein, Potassiumage and Rhizobacterin) and (Easternabiofert at 150 Kg/fed. plus RD of organic manure) gave the maximum values in auxins, gibberellins and cytokinins while it gave the highest reduction of abscisic acid in leaves of sweet pepper at 95 days after transplanting during 2012 season.

4- Flowering characters:

With respect to the effect of bio organic and mineral fertilizers on some flowering characters of sweet pepper data illustrated in Table (3) clear that, four treatments (1st; RD of NPK and farmyard manure, 2nd; 75% RD plus Phosphorein, Potassiumage and Rhizobacterin and 3rd and 4th; Easternabiofert at 100 or 150 Kg/fed. plus RD of organic manure) recorded significantly decreased number of days to flowering, increased fruit set (%)as well as number of flowers per plant, in both seasons.

Table 2. Effect of some bio organic and mineral fertilizers on the chemical composition of sweet pepper leaves during 2011 and 2012 seasons (Abbreviations as mentioned in Table 1)

Treatments	Chlorophyll a	Chlorophyll b	Chlorophyll a + b	Carotenoids	N	P	K
	(mg/g fresh weight)				(dry weight %)		
Season 2011							
Es 50	0.574±0.004	0.376±0.002	0.95±0.006	0.451±0.006	2.16±0.05	0.401±0.006	4.00±0.15
Es 100	0.601±0.002	0.401±0.003	1.002±0.005	0.485±0.006	2.28±0.03	0.409±0.009	4.01±0.13
Es 150	0.632±0.008	0.425±0.004	1.057±0.004	0.511±0.007	2.63±0.01	0.428±0.006	4.04±0.04
Comp 10	0.514±0.006	0.329±0.003	0.843±0.009	0.377±0.004	1.89±0.04	0.401±0.009	3.92±0.12
Comp 15	0.542±0.011	0.359±0.005	0.901±0.016	0.429±0.009	2.15±0.04	0.409±0.007	3.99±0.11
Comp 20	0.609±0.008	0.419±0.003	1.028±0.011	0.486±0.005	2.37±0.07	0.429±0.008	4.04±0.07
75%RD+Bio	0.651±0.01	0.445±0.005	1.096±0.015	0.524±0.01	2.71±0.05	0.448±0.011	4.09±0.09
RD (control)	0.674±0.006	0.438±0.004	1.112±0.01	0.541±0.007	2.99±0.09	0.451±0.007	4.17±0.04
L.S.D. at 5%	0.059	0.037	0.099	0.061	0.39	0.024	N.S
Season 2012							
Es 50	0.619±0.009	0.394±0.004	1.013±0.013	0.476±0.0114	2.11±0.06	0.424±0.116	3.80±0.12
Es 100	0.632±0.007	0.406±0.006	1.038±0.013	0.506±0.290	2.32±0.07	0.431±0.006	3.87±0.11
Es 150	0.671±0.011	0.431±0.003	1.102±0.012	0.532±0.003	2.74±0.1	0.445±0.009	3.92±0.12
Comp 10	0.552±0.004	0.348±0.008	0.900±0.012	0.389±0.009	1.93±0.04	0.405±0.005	3.61±0.06
Comp 15	0.601±0.007	0.362±0.007	0.963±0.014	0.464±0.004	2.21±0.07	0.416±0.010	3.75±0.15
Comp 20	0.643±0.004	0.419±0.01	1.062±0.014	0.503±0.009	2.38±0.08	0.438±0.008	3.84±0.12
75%RD+Bio	0.682±0.01	0.447±0.007	1.129±0.017	0.531±0.0612	2.99±0.1	0.449±0.010	3.91±0.06
RD (control)	0.697±0.012	0.469±0.012	1.166±0.024	0.562±0.008	3.05±0.06	0.465±0.005	3.99±0.10
L.S.D. at 5%	0.081	0.048	0.109	0.135	0.45	0.031	N.S

- N.S.= Non Significant

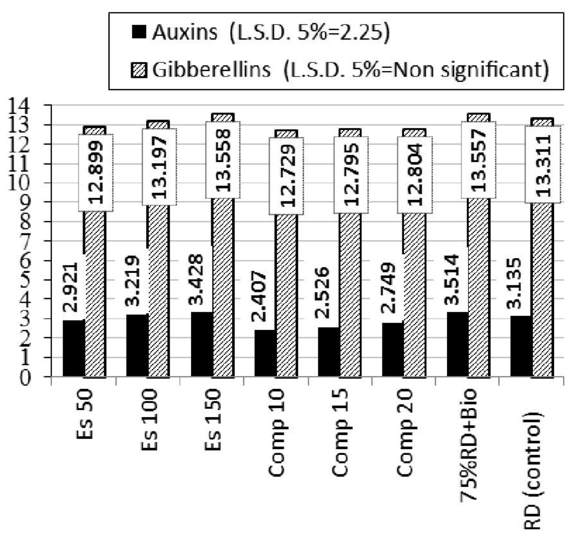

Figure 1. Effect of some bio organic and mineral fertilizers on Auxins and Gebberellins, (µg/g FW) of sweet pepper shoots at 95 days after transplanting in the second season (2012)

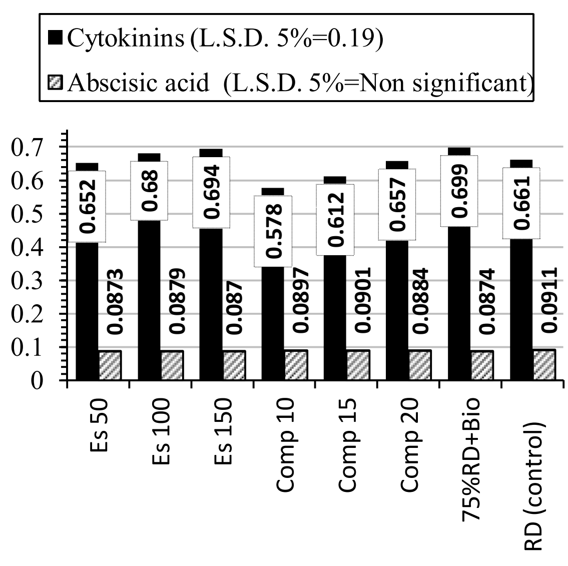

Figure 2. Effect of some bio organic and mineral fertilizers on Cytokinins and Abscisic acid (µg/g FW) of sweet pepper shoots at 95 days after transplanting in the second season (2012)

Table 3. Effect of some bio organic and mineral fertilizers on some floweringcharacters of sweet pepper plants during 2011 and 2012 seasons (Abbreviations as mentioned in Table 1)

Treatments	No. of days to flowering	No. of flowers /plant	Fruit set (%)
First season 2011			
Es 50	62.4±1.5	51.9±1.4	39.2±0.4
Es 100	60.1±0.6	53.7±0.7	40.1±0.6
Es 150	59.7±0.7	54.7±0.8	40.9±0.9
Comp 10	65.9±1.5	51.1±0.7	36.7±0.7
Comp 15	64.5±1.1	51.7±1.0	37.9±0.8
Comp 20	63.2±0.7	52.4±1.2	38.7±0.7
75%RD+Bio	58.9±1.0	54.5±0.9	41.5±0.6
RD (control)	58.1±1.1	55.1±1.1	41.4±0.4
L.S.D. at 5%	2.69	1.75	1.99
Second season 2012			
Es 50	62.8±1.4	55.1±0.6	38.9±0.9
Es 100	62.3±0.9	56.2±0.7	40.1±0.6
Es 150	60.9±0.9	56.6±0.6	40.9±0.9
Comp 10	65.4±1.2	51.9±0.9	36.4±0.5
Comp 15	65.1±1.1	53.2±0.6	37.3±0.8
Comp 20	64.4±0.5	55.6±0.6	38.2±1
75%RD+Bio	59.5±0.2	57.3±0.5	41.4±0.7
RD (control)	60.9±1.1	57.1±0.3	41.9±0.8
L.S.D. at 5%	2.21	1.14	1.56

Table 4. Effect of some bio organic and mineral fertilizers on the physical fruit characters of sweet pepper plants during 2011 and 2012 seasons (Abbreviations as mentioned in Table 1)

Treatments	Av. fruit weight (g)	Fruit No. / plant	Fruit length (cm)	Fruit diameter (cm)	Fruit wall thickness (cm)	Fruit dry wt. (%)
First season 2011						
Es 50	51.2±0.6	10.4±0.2	7.5±0.1	5.0±0.1	0.20±0.01	7.01±0.07
Es 100	52.9±0.9	11.2±0.3	7.7±0.2	5.0±0.1	0.21±0.01	7.24±0.06
Es 150	56.8±0.7	11.9±0.4	7.9±0.1	5.1±0.1	0.23±0.01	7.95±0.10
Comp 10	45.3±0.4	9.2±0.3	7.4±0.3	4.8±0.1	0.15±0.01	6.22±0.04
Comp 15	49.9±0.8	9.8±0.4	7.5±0.2	4.9±0.1	0.18±0.01	6.57±0.09
Comp 20	55.2±0.3	11.4±0.3	7.7±0.5	5.0±0.1	0.21±0.01	7.87±0.07
75%RD+Bio	58.1±0.6	13.1±0.6	7.9±0.1	5.2±0.1	0.24±0.01	8.05±0.04
RD (control)	59.9±0.8	12.7±0.2	7.9±0.3	5.2±0.1	0.24±0.01	8.24±0.07
L.S.D. at 5%	2.96	1.25	N.S	N.S	0.01	0.36
Second season 2012						
Es 50	52.7±0.8	10.5±0.1	7.8±0.1	5.0±0.1	0.20±0.01	7.41±0.02
Es 100	55.6±0.6	12.2±0.2	7.8±0.1	5.1±0.0	0.21±0.01	7.85±0.06
Es 150	60.9±0.9	13.7±0.3	7.9±0.1	5.2±0.1	0.24±0.02	8.34±0.04
Comp 10	50.7±0.7	9.4±0.1	7.7±0.1	4.8±0.1	0.17±0.01	7.01±0.07
Comp 15	52.9±0.4	10.9±0.3	7.7±0.1	4.9±0.1	0.18±0.01	7.55±0.05
Comp 20	59.8±0.3	12.2±0.2	7.7±0.1	5.0±0.1	0.22±0.01	8.29±0.08
75%RD+Bio	62.1±0.7	14.1±0.3	8.0±0.2	5.2±0.2	0.24±0.02	8.44±0.08
RD (control)	63.4±0.7	14.8±0.4	8.1±0.1	5.1±0.1	0.26±0.01	8.61±0.05
L.S.D. at 5%	2.79	1.15	N.S	N.S	0.03	0.21

N.S.=Non Significant

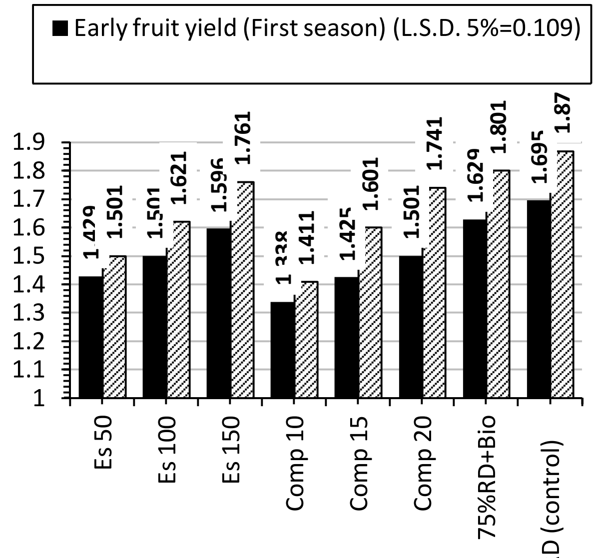

Figure 3: Effect of some bio organic and mineral fertilizers on early yield (tons/fed.) of sweet pepper plants during 2011 and 2012 seasons

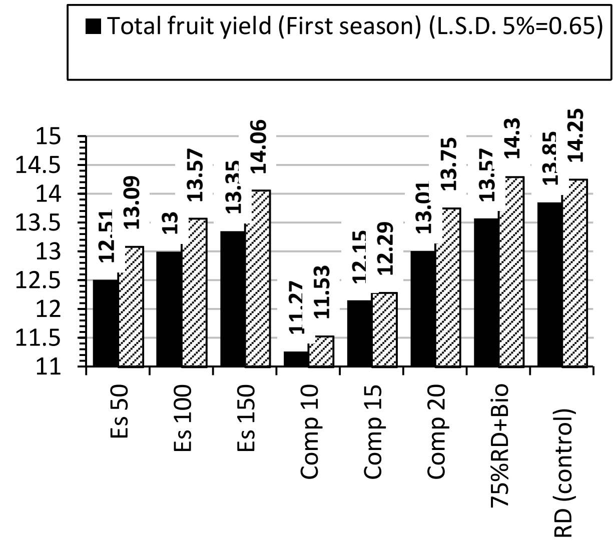

Figure 4: Effect of some bio organic and mineral fertilizers on total yield (tons/fed.) of sweet pepper plants during 2011 and 2012 seasons

Table 5. Effect of some bio organic and mineral fertilizers on some chemical composition of sweet pepper fruits during 2011 and 2012 seasons (Abbreviations as mentioned in Table 1)

Treatments	**Vitamin C (mg 100g^{-1} FW)**	**NO_3 (mg kg^{-1} FW)**	**TSS (%)**	**Titratable acidity (%)**
Season 2011				
Es 50	102.9±2.4	8.86±0.05	4.11±0.02	0.378±0.007
Es 100	107.9±2	8.94±0.040	4.27±0.05	0.376±0.005
Es 150	114.2±1.8	9.00±0.104	4.35±0.05	0.380±0.005
Comp 10	96.1±1.1	8.95±0.060	3.91±0.06	0.373±0.003
Comp 15	102.2±2.2	9.00±0.114	4.10±0.03	0.372±0.007
Comp 20	112.5±2.5	9.00±0.030	4.25±0.06	0.379±0.009
75%RD+Bio	115.7±1.6	9.53±0.040	4.39±0.09	0.385±0.007
RD (control)	119.8±2	10.13±0.065	4.57±0.07	0.381±0.010
L.S.D. at 5%	8.4	0.29	0.59	N.S
Season 2012				
Es 50	108.1±2.1	8.89±0.050	3.87±0.06	0.364±0.006
Es 100	115.9±2.0	9.03±0.030	3.95±0.05	0.368±0.007
Es 150	121.5±1.5	9.12±0.060	4.04±0.04	0.370±0.007
Comp 10	97.5±1.5	9.01±0.060	3.64±0.03	0.365±0.005
Comp 15	109.5±2.5	9.11±0.070	3.75±0.05	0.362±0.006
Comp 20	119.1±1.5	9.25±0.080	3.92±0.07	0.370±0.008
75%RD+Bio	125.1±2.1	9.89±0.080	4.03±0.03	0.371±0.004
RD (control)	124.5±1.4	10.35±0.100	4.11±0.07	0.374±0.007
L.S.D. at 5%	6.9	0.32	0.25	N.S

- N.S.= Non Significant

Table 6. Effect of some bio organic and mineral fertilizers on some chemical composition of sweet pepper fruits during 2011 and 2012 seasons. (Abbreviations as mentioned in Table 1)

Treatments	N	P	K	Crude protein	Total carbohydrates (mg/g dry weight)
	(Dry weight %)				
Season 2011					
Es 50	1.39±0.03	0.304±0.004	1.79±0.03	8.69±0.05	639.12±9
Es 100	1.43±0.03	0.329±0.008	1.91±0.05	8.94±0.04	654.37±4
Es 150	1.46±0.02	0.348±0.005	2.00±0.03	9.12±0.06	671.05±10
Comp 10	1.20±0.03	0.245±0.005	1.59±0.05	7.50±0.05	620.25±8
Comp 15	1.21±0.04	0.279±0.003	1.73±0.03	7.56±0.06	632.59±49
Comp 20	1.37±0.05	0.309±0.007	1.94±0.04	8.56±0.06	657.14±7
75%RD+Bio	1.48±0.03	0.338±0.006	1.99±0.08	9.25±0.07	681.58±9
RD (control)	1.50±0.04	0.359±0.009	2.09±0.04	9.37±0.07	679.28±10
L.S.D. at 5%	0.19	0.030	0.11	1.15	26.8
Season 2012					
Es 50	1.45±0.02	0.310±0.005	1.95±0.01	9.06±0.02	644.87±9
Es 100	1.47±0.01	0.332±0.003	2.03±0.03	9.19±0.04	652.58±10
Es 150	1.51±0.03	0.361±0.006	2.12±0.05	9.44±0.04	671.64±11
Comp 10	1.31±0.01	0.264±0.004	1.75±0.02	8.56±0.06	617.63±6
Comp 15	1.37±0.02	0.293±0.003	1.87±0.03	8.75±0.01	632.74±7
Comp 20	1.41±0.02	0.317±0.007	2.01±0.06	9.50±0.08	657.89±10
75%RD+Bio	1.52±0.03	0.379±0.009	2.19±0.07	9.50±0.07	678.95±8
RD (control)	1.54±0.04	0.398±0.006	2.23±0.07	9.62±0.07	682.44±7
L.S.D. at 5%	0.09	0.042	0.14	0.29	31.1

5- Yield parameters:

Data in Table (4) and Figures (3 and 4) indicate that significant increases in Fruit fresh and dry weight, number of fruits per plant, fruit wall thickness, early and total yield were existed with the tested applications of bio organic and mineral fertilizers during the two assigned seasons, while the differences among fruit length and fruit diameter were insignificant. The three treatments (1st; RD of NPK and farmyard manure, 2nd; 75% RD plus Phosphorein, Potassiumage and Rhizobacterin and 3rd; Easternabiofert at 150 Kg/fed. plus RD of organic manure) gave the highest values. There were no significant differences between these treatments in both seasons. Such increments in flowering and fruit yield might be correlated with their effect on increasing the vegetative growth parameters (Table, 1) photosynthetic pigments and chemical composition (Table 2) which affect plant growth and in turn increased it's productivity. Similar positive responses were reported by **Abdalla*et al* (2001)**; **Abdalla, (2002)**; **El-Shaikh, (2005)**; **Shaheen*et al.*, (2007)**; **Najafv and Direkvandi*et a*l., (2008)**; **Ahmed, (2009)**; **Midan and Sorial (2011)**; **Hassan *et al.*, (2012)** and **Shehata*et al.*, (2012)** on different crops.

6- Chemical composition of leaves and fruits:

Leaf contents of N and P were significantly affected by applications of bio organic and mineral fertilizers, while K concentrations were insignificant, in both seasons (Table 2). In fruits, the different as between all treatments were significantly increased concentrations of vitamin C, TSS, N, P, K, Crude protein and total carbohydrates but titratable acidity was not affected in both seasons (Tables 5 and 6). The three treatments (1st; RD of NPK and farmyard manure, 2nd; 75% RD plus Phosphorein, Potassiumage and Rhizobacterin and 3rd; Easternabiofert at 150 Kg/fed. plus RD of organic manure) recorded the highest values. Sweet pepper plants fertilized with bio- organic fertilizers combined without the mineral fertilizers gave the lowest values of nitrate in fruits in the two growing seasons.

4. Discussions

From the previous results, it could be concluded that the growth characters and yield component of sweet pepper plants were improved as a result of applying different fertilization sources. Generally, the three treatments; (the first was recommended dose of NPK and farmyard manure, the second was 75% recommended dose plus Phosphorein, Potassiumage and Rhizobacterin the third treatment was Easternabiofert at 150 Kg/fed. plus recommended dose of organic manure,) resulted in the maximum measurements followed by compost at 20 ton/fed.

It is well known that the chemical fertilizers promote plant growth through the role of nitrogen in proteinsynthesis and increasing the meristmatic activity. In this respect, Marschner (1995) stated that a change in the supply nutrients to the roots, nitrogen in particular, can markedly modulate not only the levels but also the balance of phytohormonesinplant. The application of nitrogen fertilizers can therefore affect growth and development not only directly (supplying nitrogen as a constituent of protein) but also indirectly by changing the phytohormones balance. In addition, mineral-P is an essential component of the energy compounds (ATP and ADP) and phosphoproteins.These results are in accordance with the findings of **Mahfouz and Sharaf-Eldin (2007), Hassan (2009) and Hassan *et al*., (2012)**.

The promotion effect of compost on the growth and yield of sweet pepper plant could be explained through the role of organic materials including composts in improving soil P availability (Reddy ***et al.,*** 2005; Gichangi ***et al.,*** 2009). Since during composting, labile nutrients are converted intostabilised organic material (**Zucconi and De Bertoldi, 1987**), therefore a large proportion of nutrients are labile. Composts provide microbes not only with P but also C and N and are therefore likely to induce changes in P pools that differ from those of inorganic P addition. In addition, compost led to increase protein content **(Kanwar and Paliyal (2002)**, **Sharma *et al.* (2006)** and fertilization with organic manure increased not only available nitrogen but also exchangeable potassium insoil**(Ohalloranset *al*., 1993)**.

Promoting the growth characters and increasing the yield component of sweet pepper plant by using Easternabiofert could be attributed to the effect of non symbiotic N2-Fixing and phosphate solubilizing bacteria in exerting a positive effect on plant growth through the synthesis of phytohormones, N2 fixation, reduction of membrane potential of the root, synthesis of some enzymes (such as ACCdeaminase) that modulate the level of plant hormones as well as the solubilization of inorganic phosphate and mineralization of organic phosphate, which make phosphorus available to the plants **(Rodriguez and Fraga,1999)**.

Increasing the microorganisms in the soil had a positive effect in converting the unavailable forms of nutrient elements to available forms. The microorganisms also produce growth promoting substances resultingin more efficient absorption of nutrients, which main components of photosynthetic pigments and consequently the carbohydrate as well as N, P and K percentages were increased **(Gomaa and Abou-Aly, 2001)**. In addition, the non symbiotic N2-fixing bacteria, produced adequate amounts of IAA and cytokinins with increasing the surface area per unit of root length and enhanced the root hair branching with an eventual increase on the uptake of nutrients from the soil **(Rodriguez and Fraga, 1999)**. Phosphate solubilizing bacteria release organic and inorganic acids which reduce soil pH leading to change of phosphorus and other nutrients to available forms ready for uptake by plants **(Singh and Kapoor,1999)**. Therefore, the percentages of N, P and K elements in the leaves and fruits were increased and this increment led to promote the growth and yield of sweet pepper plants.

The micro-organisms play central role in the natural phosphorus cycle, this cycle occurs by means of the cyclic oxidation and reduction of phosphorus compounds, where electron transfer reactions between oxidationstages range from phosphine to phosphate **(Ohtakeet *al*., 1996)**. The positive effect of bio-fertilizers on plant growth may be for its containing Azotobacter and Azospirillum, which produced adequate amounts of IAA andcytokinine, thus increased the surface area per unit of root length and responsible forroot hair branching with aneventual increase in uptake of nutrients from the soil **(Jagnowet *al*., 1991)**.

Conclusions

From the previous results, it could be concluded that applying 75% of the recommended dose of NPK and organic manure plus Phosphorein, Potassiumage and Rhizobacterin or Easternabiofert at 150 Kg/fed. plus recommended dose of organic manure can be used in sweet pepper production without reducing the productivity and quality. These biofertilizers treatments will reduce the cost of chemical fertilizer, avoid the risk of nitrate accumulation in the edible portions and decrease the pollution of the environment. Also, applying the compost at 20 ton/fed. leads to lower productivity compared to the full dose of mineral fertilizers, but the resulting yield will be higher in price, achieving more profit for the producers.

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11/12/2013