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Organic husk tomato (*physalis peruviana,l.*)Production for exportation.

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ABSTRACT

Two field experiments were conducted at El-Baramoun Farm, Mansoura Horticulture Research Station,Dakahlia Governorate, Egypt during two successive fall seasons of 2013 and 2014 to study the influence of soil amendmentwith sulfur and three levels of combinations between compost manure and mineral NPK fertilizers as well as their interaction on growth, chemical composition,yield and fruit quality of husk tomato plant cv. Balady. The experimental design was split plot design with three replicates. The vegetative growth traits of husk tomato, chemical composition, total chlorophyll content, yield and its component and fruit quality had high significant values by soil amendment with sulfur, except for numberof branches and carotenoid content in both seasons and number of leaves in first season, since the increase was not significant at 5%. Supplementation of organic manure (compost)at 6.5 ton/fed with 50% from mineralNPK fertilizers improved plant growth and induced significant increases in yield and fruit quality. The application of sulfur with a mixture of 50% mineral NPK,50% compostand 200kg mineral sulfur had synergetic effect on increasing yield by18.51 and 19.00%in both seasons, respectively and enhancing fruit quality compared with conventional agricultural practice.It can be concluded that the treatment of the mixture of 50% mineral NPK and 50% compost with sulfur amendment was the best treatment for plant growth, yield and fruit quality as well as for reducing 50% of organic and inorganic fertilizers. The economic performance of husk tomato under this study showed that although organic treatment with 200kg sulfur gave the lowest yield, it gains the highest net return and benefit cost ratio(16745 and 2.190, respectively) comparing with conventional practice, thus this treatment i. e., 100%compost, that equal the same content of 100% mineral NPK recommendation, with sulfur amendmentproved to be the economical for organic husk tomato production under the conditions of Nile Delta lands.

Keywords:*Physalis peruviana*, compost, mineral fertilizers, net return

INTRODUCTION

Growing consumer demand for new crops as a purpose of diversification, especially if it can be used the suggested crop for different purposes i. e., local consumption, exportation and processing and this requires new information on the growth habits, production and quality of different species. Husk tomato (*Physalis peruviana, L.*) is a promising horticultural crop also known as poha, golden berry, cape gooseberry, tomatillo, alkekengi and ground cherry are gaining popularity in the specialty markets. This crop is grown not only for edible fruit which eaten raw, as a dessert, jams, dehydrated fruits, sauces, appetizers or used as dish decorations, but also for its nutritional value i.e., its content of vitamin A and C, minerals, particularly P, Fe and fibers (Rehm *et .al*.,1991, Fischer *et.al*.,2000 and Ramadan *et.al*.,2000). Although it is a non-traditional horticultural crop in Egypt, it is widely used as folk medicine as a diuretic, for treating diseases such as malaria, asthma, hepatitis, dermatitis and rheumatism(Wu *et. al*., 2005), worm complaints (Ahmad *et. al*.,1999) , secreting the bile juice and activating the liver function (Stray,1983). Also, it shows antibiotic activity (Perry and Metzger, 1980). The high β-carotene content of husk tomato has the potential of an anticarcinogenic effects (Steinmetz *et.al*., 1996) and antioxidant (Rop*et.al*.,2012). Nowadays, it is used in homeopathy for the same purpose. Nutritional considerations and health benefits bring the husk tomato to the forefront. Therefore, in Egypt, a great attention is given for promoting this promising crop,husk tomato, production and quality to meet the progressive demand of local fresh markets, medicinal purposes, developing processing industry and rapid growing of exportation (Mustafa, 2009).Organic agriculture of husk tomato in old lands of Egypt can be established because of its high resistance to insects, since it is covered with hairs, to diseases, so there is a trend to use it as rootstock in grafting procedure, and to reverse environment conditions.

In conventional practice, improved cropping system involving high value crops rely on the use of chemical fertilizer due to its immediate availability of nutrients. Indiscriminate and continuous use of such chemical fertilizers leads to instability in yield and also poses a threat to soil health particularly due to micronutrients deficiency and fertilizer related environment pollution (Kalloo, 2003). With intensification of cropping and heavy use of chemical fertilizers, the supplementary and complementary roles of organic materials are being strongly felt for retaining soil productivity (Laudicina*et al*., 2011). Therefore, recently, there have been trend toward the use of organicvegetables that have no harmful artificial chemicals. Although, higher price of organically produced food than conventional one was noticed, there is an increase in consumer demand, especially for exportation, which prompting producers to grow crops organically.Organic matter improves the physical, chemical and biological properties of various soils.The addition of organic matter (OM) can accelerate the leaching of Na, decrease electrical conductivity (EC), increase water infiltration, water-holding capacity and aggregate stability (Qadir*et al*. 2001). This is particularly important for agricultural soils deficient in organic matter, such as those in the Egypt region (1–3% OM) (Mahdy,2011).The use of compost in clay soils has several special benefits *i.e*., improves drainage while maintaining the ability to retain water in soil, collects clay particles to form more good granular soil aeration and drainage, helps keep the soil porous so that air and water to move freely through the soil and helps the roots to penetrate easily through the soil. The organic enrichment is most common through the application of composted materials,microbial biofertilizer or recycling crop wastes.

Compost products have gained impetus in organic farming to boost agricultural production to its important multi various features such as being rich in nutrients, vitamins, growth regulators, free from pathogens and containing immobilized microflora (Moghazy*et. al.*,2014). These composts provide all nutrients in readily available forms and also enhance uptake of nutrients by plants and play a major role in improving growth and yield of different field crops.Hassan *et. al.*, (2007) found that compost manure application at a rate of 15 t/fed., with a half rate of recommended NPK significantly affected the quality and mineral content of NPK in seeds of pea plants. Kamal and Ghanem (2011) stated that the increment in yield parametersand the enhancement of fruit quality of capegooseberry plants were observed as affected by organic matter (poultry, sheep or farmyard manure) amendments. Moreover, Moghazy*et.al.*,2014 found that the highest values of all vegetative growth traits, total yield, and yield components of pea, NPK content, protein % and total sugar as well as carbohydrate % in fresh seeds were obtained from a mixture of nitrogen fertilizer at levels 60 kg Nfed^{-1} and compost at 2.5 ton fed^{-1}

Moreover,sulfur is considered as one of the major essential plant nutrients and an amendment used for reclaiming alkaline and calcareous soils (Marschner, 1995). In agriculture, it is mostly used as a livestock supplement, soil amendment, insect management product and fungicide. Sulfur fertilization is relatively inexpensive and its use leads to substantial benefits of yield and quality of crops. Since clayey soils of Egypt possess extremely poor organic matter and high pH, which directly influence the availability of nutrients for plant growth. Elemental sulfur (S) can be used as a nutrient and an acidifier. The acidity produced during elemental S oxidation increases the availability of nutrients such as P, Mn, Ca and SO_4 in soils (Lindemann*et al.*, 1991), which may enhance the chemical and physical characteristics of alkaline soils. In plants,nitrogen and sulfur are utilized mostly for protein synthesis and it is necessary for the synthesis of amino acids, proteins and other cellular components which play an important role in the protection of plants against stress and pests (Luit*et al.*, 1999).It has been shown to play an important role in yied and quality of crops (Pavlista, 2005 and Bielinski et al., 2007).

MATERIALS AND METHODS

Tow field experiments were carried out at El-Baramoun Farm, Mansoura Horticulture Research Station, Dakahlia Governorate, Egypt during two successive fall seasons of 2013 and 2014 to study the effect of mineral sulfur in the presence of organic manure i e., compost and some levels of NPK mineral fertilizers on growth, chemical composition, yield and its quality of husk tomato (*Physalis peruviana,L.*) cv. Balady as a local variety in Egypt. Table1 shows some physical and chemical properties of the experimental soil at a depth of 0-30 cm according to the method of Piper (1950) are shown in.Husk tomato seedling at 40 days old were transplanted at 70cm apart between the seedlings on one side of ridge,5 m long and 1 m width with experimental unit area of 15 m^2.

Table (1): Physical and chemical properties of the experimental soil during 2013 and 2014 seasons

Chemical analysis	2013	2014
Physical analysis (%)		
Sand	19.78	19.60
Silt	28.10	29.22
Clay	52.12	51.18
Soluble ions in saturation extract 1.5 (meq / 100g soil)		
Ca^{++}	0.930	0.988
Mg^{++}	0.466	0.457
Na^{+}	2.020	2.110
K^{+}	0.222	0.182
HCO_3^-	0.490	0.530
Cl^-	1.232	1.242
$SO_4^{=}$	2.285	2.200
pH	8.12	7.93
EC 25^{0}C (mmohs / cm)	0.542	0.5311.455
Organic (matter%)	1.331	
Nitrogen: (mg / 100 g soil)		
Total	172.66	190.55.205
Available	4.250	
Phosphorus: (mg / 100 g soil)		
Total	14.453	15.701
Available	7.240	8.624
Soluble	3.186	3.161
Potassium: (mg / 100 g soil)		
Total	51.00	53.31
Available	0.311	0.233
Soluble	0.205	0.188

The experiment was adopted in split plot design with three replicates containing 6 treatments, which were the combination between mineral sulfur at the rate of 200 kg/fed and without S as well as three levels of fertilizers i.e., the recommendation of mineral NPK fertilizers, 50% of NPK mineral recommendation with 50% of compost and total amount of compos, which equal the same levels of mineral NPK but in form of organic matter. The mineral sulfur was distributed in the main plot, the fertilizer levels were arranged in the sub plot as follows:

1- Mineral NPK recommendation of husk tomato i.e., 150kg N+ 70kg P_2O_5+140kg K_2O(as control).
2- 50%from the totalamount of compost i. e., 6.5 ton/fed + 50% from the NPK mineral fertilizers recommendation without sulfur.
3- Compost manure (1.1%N+ 0.42% P_2O_5 +1.22% K_2O) at the rate of 13.5 ton/fed , while this amount equal the same content of 100% mineral NPK recommendation.
4- Mineral NPK recommendation + 200kg mineral sulfur.
5- 50% from the total amount of compost i.e., 6.5 ton/fed + 50% from the NPK mineral fertilizers recommendation + 200kg mineral sulfur.
6- Compost manure at the rate of13.5 ton/fed + 200 kg mineral sulfur.

Chemical analysis of compost manure is shown in Table 2.The compost consisted of animal wastes and plant residues (70% vegetable waste+20% animal waste +10% humicacid) and was obtained from the Egyptian company for solid waste recycling (ECARO). The quantity of compost manure were calculated based on total nitrogen content of compost to provide 150 kgN /fed.

Table (2): Chemical analysis of the compost manure during 2013 and 2014 seasons.

Compot manure	Weight of m3 (kg)	pH	EC dS/m	OM %	C:N ratio	Total Humus %	Total N%	Total P%	Total K%	Mg %	Fe ppm	Zn ppm	Mn ppm
2013	615	7.5	3.6	32.0	18.1 : 1	23.10	1.1	0.41	1.22	0.21	650	44	160
2014	635	7.3	3.8	31.4	18.3 : 1	21.05	1.1	0.43	1.23	0.19	680	50	172

Husk tomato seedlings were transplanted on 7th and 5th August, respectively. Sulfur at 200kg/fed was thoroughly mixed with the soil prior to planting. In organic agriculture practice, compost at 13 ton/fed was incorporated into the soil before planting.However in conventional one,as a source of nitrogen, sulphate ammonium (20.6 % N) was used and added as equal doses (100kg/fed) before the first irrigation, 200kg at the beginning of flowering and 200kg at the beginning of fruit set in addition to 150kg/fed ammonium nitrate (33.5% N) after the first piking.Superphosphate (15.5 % P_2O_5) was added as only one addition during soil preparation with rate of 70 Kg P_2O_5/ fed. Potassium sulphate (48 % K_2O) was added with rate of 140 kg K_2O/fed as three equal doses (100kg) before the first irrigation, at the beginning of fruit set and after the second piking.Other normal cultural practices for husk tomato were followed according to the instruction laid down by Egyptian Ministry of Agriculture.

Data recorded:

1- Vegetative growth characteristics

Representative samples of five plants were taken randomly from each plot at 90 days after transplanting to obtain the following traits; plant height,number of leaves/plant, number of branches/plant,fresh weight/plant (g) and dry weight/plant (g).

2- Totalchlorophyll and mineral contents in leaves:

Total chlorophyll was determined as described by Wettstein (1957). Also nitrogen content was determined in the dry matter of leaves using the micro keldahl apparatus according to Cotteni *et al.*, (1982). Phosphorus was determined calorimetrically according to Sandell (1950). Potassium was determined according to Horneck and Hanson (1998).

3- Yield and physical characteristics of the fruit:

At the proper maturity stage, number of fruits per plant (random mean of ten plants), average weight and diameter of fruit (mean of 20 fruits from each replicates) were determined. Early yield (the sum of the first three pickings) and total yield as kg/plot were recorded, then calculated as ton/fed.

4-Fruit chemical contents:

At the middle of harvesting season, a representative sample of 100 g fruits from each experimental plot were taken to determine quality characteristics of husk tomato fruits.Total sugars were determined colorimetrically as described by Smith *et al.*,(1956). Total carotenoids content, ascorbic acid and titratable acidity were determined according to the method of A.O. A.C.(1990).

5- Economic Performance:

Economic performance of husk tomato plants i.e., gross return, treatment cost, total variable cost, net return and benefit-cost ratio were calculated based on market prices as average of the two seasons. The benefit-cost ratio was determined according to Boardman et al (2001) by dividing the net return (LE/ fed) on total variable cost (LE/ fed).

Statistical analysis:

Correlation between fruit yield and either fresh weight of plant or leaf chlorophyll content, correlation between leaf chlorophyll content and fruit sugars content and correlation between leaf N% and fruit carotenoid content were analyzed and data were statistically subjected to analysis of variance (ANOVA) and the means were compared using the Least Significant Difference test (L.S.D.) at 5% level according to CoState(Version 6.303, CoHort, USA, 1998-2004).

RESULTS AND DISCUSSION

Vegetative growth traits:

Table 3 obviously indicates that vegetative growth traits of husk tomato i.e., plant height, number of leaves, number of branches, fresh weight and dry weight increased significantly by sulfur amendment to the soil compared with the control treatment (without sulfur) in both seasons, except number of leaves in the first season and number of branches in both seasons which these increases did not reach to the significance level at 5%. Such data also illustrate that the treatment of 50% mineral NPK mixed with 6.5 ton/fed compost was the superior in increasing all vegetative growth traits, except for dry weight which the difference between conventional production and 50% mineral NPK+50%compost treatment did not reach to the significance at 5/% level. However, treatment of compost only(without adding either sulfur or mineral NPK) gave the lowest records in both seasons of this study. Concerning with the interaction effect between sulfur and fertilization, data in the same table reveal that plants received 50% NPK + 50% compost gave the highest records of all studied parameters compared with other treatments in both seasons. However, the lowest values in all growth criteria were distinct when supplemented with 13 ton/fed compost without sulfur.These results may be attributed to the fact that compost enhanced physical and chemical properties of the soil and enriched it with nutrients in available form. Besides the lowering pH of sulfur which increases nutrients solubility in alkaline soil in addition to synthesis of protein, chlorophyll, vitamins and numerous secondary metabolites in plant cell.

These results are in harmony with those of Moghazy *et al.*, (2014) who stated that the highest records of plant length, number of leaves, number of branches and dry weight were obtained when pea plant fertilized with 60kg N + 2.5ton compost /fed.The positive effect on growth traits by using compost manure might be related to the improvement of physical conditions of the soil and supplying plant with mineral nutrients, i.e., N.P.K and micronutrients (Fe, Zn and

Mn), organic matter as well as humic acid content (Rechcigl, 1995).On the other hand,Kanu*et al*., (2013) found that among the treatments of optimal dose of nutrients, theVC100 (100%virmicompost)has shown significant reduction in dry matter as compared to CF100 (100%chemical fertilizers) or VC50 + CF50 treatment. At harvest, VC50 + CF50 treatment was statistically at par with CF100 and they were significantly superior to VC100.Moreover, sulfur application significantly increased plant height and number of leaves of chrysanthemum (Huang *et al*., 1997).

Table (3): Vegetative growth parameters of husk tomato plant as affected by sulfur application, compost manure, mineral fertilization and their interaction during seasons of 2013 and 2014.

treatments	Plant height (cm)			No of leaves /plant			No of branches /plant			Fresh weight (g/plant)			Dry weight (g/plant)		
	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean
Sulfur application															
S0	91.7	93.1	92.39	149.7	152.3	150.5	15.66	16.89	16.28	485.8	531.0	508.4	162.3	174.2	168.3
S1	97.9	99.4	98.69	151.9	151.1	152.2	16.14	17.11	16.63	604.7	736.1	670.4	172.7	188.2	180.5
LSD 5%	1.08	1.05	1.07	1.404	0.596	1.00	0.530	0.429	0.48	5.92	10.64	8.28	5.452	3.92	4.686
Fertilizers rate															
100%CF	98.8	99.8	99.20	148.5	150.0	149.3	15.76	16.33	16.05	789.0	658.7	723.9	186.7	188.2	187.5
Fert. 50%CF+50%C	98.6	100.4	99.5	157.3	160.8	159.1	18.00	19.33	18.67	479.0	824.0	651.5	184.7	189.5	187.1
100% C	87.1	88.8	87.95	145.0	146.5	145.8	14.50	15.33	14.92	367.7	418.0	392.9	157.2	166.0	161.6
LSD 5%	1.33	1.28	1.30	1.721	0.730	1.23	0.650	0.525	0.588	7.25	13.03	10.14	5.45	4.800	5.127
Interaction															
100%CF	96.6	97.1	96.88	147.3	149.7	148.5	15.33	16.00	15.67	442.3	514.0	478.2	152.3	185.0	163.7
S0 50%CF+50%C	93.4	94.8	94.12	154.7	161.3	158.0	17.33	19.67	18.50	670.3	677.0	673.7	180.0	185.3	182.7
100%C	85.0	87.3	86.17	144.0	146	145.0	14.33	15.00	14.67	344.7	402.0	373.4	154.7	162.3	158.5
100%CF	101.0	102.0	101.5	149.7	150.3	150.0	16.00	16.67	16.34	515.7	803.3	659.5	169.0	171.3	170.2
S1 50%CF+50%C	103.7	106.0	104.9	160.0	160.3	160.2	18.67	19.00	18.84	907.7	971.0	939.4	189.3	193.7	191.5
100%C	98.2	90.3	94.25	146.0	147.0	146.5	14.67	15.67	15.17	390.7	434.0	412.4	159.7	169.7	164.7
LSD 5%	1.88	1.81	1.85	1.85	1.033	1.73	0.920	0.743	0.832	10.25	18.43	14.34	7.711	6.788	7.250

S0: without sulfur; S1:with sulfur; Fert.: Fertilization; CF:chemical fertilizers; C: compost.

Total chlorophyll content and mineral concentrations in leaves:

Total chlorophyll, N, P and K contents in husk tomato plant were significantly increased by sulfur application as soil amendment before planting (Table4). However, the same table shows that the mixture of 50%+50%compost was the most superior in increasing total chlorophyll content and N, P and K concentrations of husk tomato leaves, while compost alone(13 ton/fed) gave the lowest records in both seasons. In respect with the interaction effect between sulfur and inorganic NPK and compost rates on chlorophyll and chemical constituents of husk tomato leaves. The data clearly indicate that all treatments were considerably differed between each other and a mixture of 50% compost+ 50% mineral NPK + elemental sulfur gave the highest values followed by100% mineral NPK with sulfur and 50%NPK +50% compost, while 100% compost without sulfur gave the lowest contents in both seasons.

Table (4): Total chlorophyll and mineral composition of husk tomato leaves as affected by sulfur application, compost manure, mineral fertilization and their interactions during seasons of 2013 and 2014.

treatments	Total chloro.(mg/g FW)			N%			P%			K%		
	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean
Sulfur application												
S0	3.745	3.797	3.771	3.609	3.638	3.624	0.239	0.248	0.244	2.463	2.473	2.468
S1	3.940	4.000	3.970	3.656	3.768	3.712	0.263	0.277	0.270	2.632	2.646	2.639
LSD 5%	0.039	0.039	0.039	0.028	0.046	0.037	0.014	0.003	0.009	0.040	0.046	0.043
Fertilizers rate												
100% CF	4.011	4.369	4.190	3.707	3.661	3.684	0.258	0.265	0.262	2.503	2.510	2.507
Fert. 50%CF+50%C	4.302	4.365	4.334	3.908	4.130	4.019	0.261	0.278	0.270	2.872	2.895	2.884
100%C	3.230	3.263	3.247	3.282	4.317	3.800	0.233	0.243	0.238	2.268	2.273	2.271
LSD 5%	0.047	0.048	0.048	0.035	0.057	0.046	0.017	0.004	0.011	0.048	0.057	0.053
Interaction												
S0 100% CF	3.911	3.980	3.946	3.710	3.653	3.682	0.253	0.260	0.257	2.373	2.383	2.378
50%CF+50%C	4.104	4.197	4.151	3.907	4.040	3.974	0.233	0.257	0.245	2.767	2.780	2.774
100% C	3.223	3.217	3.220	3.210	3.220	3.215	0.230	0.227	0.229	2.250	2.257	2.254
100% CF	4.100	4.153	4.127	3.703	3.670	3.687	0.263	0.270	0.267	2.633	2.637	2.635
S1 50%CF+50%C	4.502	4.533	4.518	3.910	4.220	4.065	0.290	0.300	0.295	2.977	3.010	2.994
100% C	3.231	3.310	3.271	3.353	3.413	3.383	0.237	0.260	0.249	2.287	2.290	2.289
LSD 5%	0.067	0.068	0.068	0.049	0.080	0.065	0.024	0.005	0.015	0.069	0.080	0.075

S0: without sulfur; S1: with sulfur; Fert.: Fertilization; CF:chemical fertilizers; C: compost.

Sulfur application significantly increased N concentration of tomato (Xu et al., 1996). The reported changes produced by the application of elemental sulfur to calcareous soils were decreased soil pH and increased availability of P, Fe, Mn, Zn and Cu (Hilal and Abd-Elfattah. 1987).Sulfur is a constituent of the amino acids cysteine and methionine and hence, part of proteins which play an important role in the synthesis of vitamins and chlorophyll in the cell (Marschner, 1995). Composts provide all nutrients in readily available forms and also enhance uptake of nutrients by plants confirms the obtained results. These results are in agreement with those of Kamal *et al*., (2011) on cape gooseberry and Moghazy *et. al*.,(2014) on pea

Fruit yield,average fruit weight and fruit diameter:

Data in Table5 clearly indicate thatsulfur application significantly increased number of fruits/plant, early and total yield per feddan, average fruit weight and fruit diameter in both seasons of this study. On the other hand, 50% mineral NPK+50% compost gave the highest early yield and fruit characters i.e., average and diameter, whereas, no significant differences were observed in total yield/fed and number of fruits/plant between conventional production and 50%mineral fertilizers+50%compost treatment, except for number of fruits/plant in the first season where the mineral NPK fertilizers was the superior.On the contrary, compost alone had the lowest effecton these parameters. Such data also indicate that the interaction effect between sulfur and fertilization rates was considerably differed in influencing yield and fruit characteristics. It is of importance to mention that treatment of mixture of 50%mineral NPK+50% compost combined with sulfur amendment gave the highest early yield and fruit characters compared with other treatments, especially the conventional agricultural practice. However, no significant difference in number of fruits/plant and fruit diameter between the treatment of 50% mineralNPK+50% compost with sulfur and that (the same treatment) without sulfur.

Table (5): Yield and fruit characteristic of husk tomato as affected by sulfur application, compos tmanure, mineral fertilization and their interactions during seasons of2013 and 2014

treatments		No of fruits/plant			Early yield (ton/fed)			Total yield(ton/fed)			Average fruit weight (g)			Fruit diameter(cm)		
		1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean
Sulfur application																
S0		127.3	135.9	131.6	0.601	0.600	0.6005	2.673	2.757	2.715	2.756	2.800	2.778	1.780	1.758	1.769
S1		141.9	154.4	148.2	0.695	0.670	0.6825	3.017	3.173	3.095	2.989	2.977	2.983	1.759	1.799	1.779
LSD 5%		5.137	1.927	3.532	0.012	0.012	0.012	0.038	0.055	0.047	0.060	0.089	0.075	0.059	0.039	0.049
Fertilizers rate																
	100% CF	138.8	141.8	140.3	0.675	0.657	0.666	2.745	2.828	2.787	2.900	2.883	2.892	1.797	1.820	1.809
Fert.	50% CF+50%C	124.8	140.0	132.4	0.815	0.832	0.845	2.775	2.870	2.823	3.283	3.300	3.292	1.950	1.950	1.950
	100% C	101.2	107.7	104.5	0.472	0.493	0.483	2.015	2.197	2.106	2.433	2.483	2.458	1.561	1.565	1.563
	LSD 5%	6.292	2.361	4.33	0.015	0.016	0.0155	0.047	0.067	0.057	0.073	0.109	0.091	0.073	0.048	0.061
Interaction																
S0	100% CF	121.3	132.0	126.7	0.603	0.600	0.6015	2.483	2.563	2.523	2.802	2.867	2.835	1.795	1.820	1.808
	50% CF+50%C	110.0	135.0	122.5	0.789	0.804	0.7965	2.540	2.690	2.615	3.133	3.133	3.133	1.967	1.930	1.949
	100% C	93.67	98.7	96.19	0.410	0.435	0.4225	1.997	2.017	2.007	2.334	2.400	2.367	1.513	1.520	1.517
	100% CF	144.3	151.7	148.0	0.711	0.714	0.7125	3.007	3.093	3.050	3.005	2.902	2.954	1.798	1.820	1.809
S1	50% CF+50%C	151.7	155.0	178.3	0.840	0.860	0.850	3.010	3.050	3.030	3.430	3.466	3.448	1.930	1.970	1.950
	100% C	108.7	116.7	112.7	0.533	0.551	0.542	2.033	2.377	2.205	2.530	2.565	2.548	1.610	1.610	1.610
	LSD 5%	8.898	3.3	6.099	0.021	0.022	0.0215	0.066	0.095	0.081	0.103	0.154	0.129	0.102	0.082	0.092

S0: without sulfur; S1: with sulfur; Fert.: Fertilization; CF:chemical fertilizers; C: compost.

Independently from the use of sulfur, no significant differences in total yield/fed were obtained between 100% NPK and the mixture of 50%NPK+50% compost in both seasons of the study. The lowest values of all parameters were observed when plants received only 13 ton/fed compost in both seasons. These results are the logic reflection of the significant increase in vegetative growth(Table 3) and total chlorophyll, N, P, and K (Table 4). This result could be explained as such treatment showed the pronounced positive effects on the vegetative growth aspects (Table 2), total chlorophyll, N, P and K contents (Table 3) leading to healthy plant and hence increasing yield aspects and it obvious clearing from the figures 1 and 2 clearly show a positive correlation between plant fresh weight and chlorophyll content of leaves from one sideand the total fruit yield to another side.

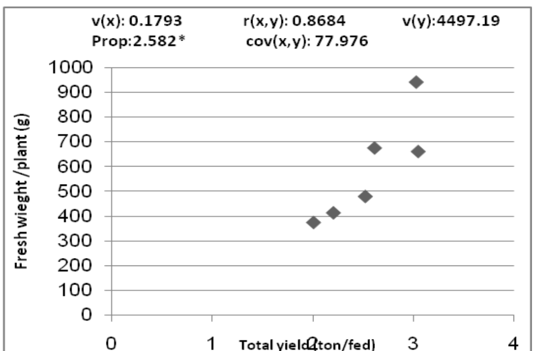
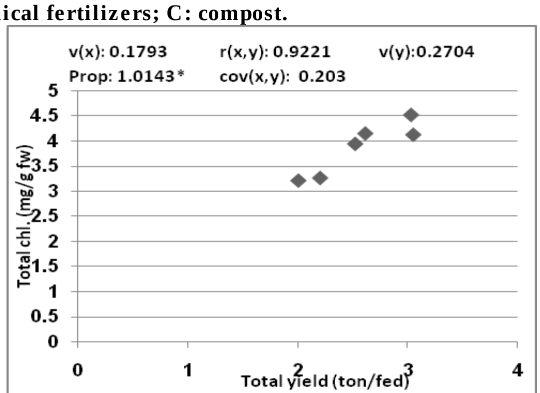


Fig (1):Correlation between fruit yield and plant fresh weight



Fig(2): Correlation between fruit yield and leaves chlorophyll content

Moreover, these results agree with those presented by Bielinski *et al.*, (2007) on tomato and Pavlista (2005) on potato, who indicate that there was a significant yield improvement with S fertilization. Concerning with fertilization procedures, these results are in accordance with those obtained by Moghazy *et.al*.,(2014) confirm that the maximum values of total yield and its components of pea were obtained when plants received nitrogen fertilizer at 60 kg N with 2.5 ton/fed compost manure.However, Kanu *et al.*, (2013) found that tomato yield was superiorin chemical fertilizers treatment (CF_{100}).In case of 50% vermicompost+50% chemical fertilizers (VC_{50}+ CF_{50}) treatment, though there was significant reduction in tomato yield during first year, in the following year the yield was observed at par. Moreover, Federico *et al.*,(2007) have reported that application of compost as vermicompost became of supplying optimum nourishment condition cause to improve quality, yield and its components.

Fruit chemical contents:

Table 6 clearly reveal that there were positive effects of sulfur application on fruit quality of husk tomato i.e., acidity%, total sugars ad vitamin C, while carotenoids content did not reach to the significance at 5% level.Increased interest in organic crops imposed the need to evaluate the quality and nutritional value of organic husk tomato. Therefore, data in the same table show that all quality criteria under study were higher in fruits of plants fertilized with 50% mineral NPK +50% compost than that of organic only or conventional agricultural practice in both seasons. The only exception was with carotenoid content in the second season where no significant difference was observed between the conventional agriculture practice and 50% mineral NPK +50% compost treatment. Results of the same table also indicate that the nutritional value of husk tomato fruit of plants that fertilized with sulfur combined and half dose of mineral NPK +6.5 ton/fed compost was the superior treatment followed by that without sulfur. However, the treatment of13 ton/fed only gave the lowest records in both seasons. These results may be attributed to the high contents of photosynthetic pigment and the significant absorption of N, P and K as shown from Table 4, in addition to Figures 3 and 4 which clear the positive correlation between chlorophyll content of leaves and total sugars of fruits and between N% of shoot and total carotenoids of fruits.

Table (6): Some chemical contents of husk tomato fruit as affected by sulfur application, compostmanure, mineral fertilization and their interactions during seasons of 2013and 201

treatments		Acidity%			Total sugars(g /100g DW)			V.C (mg/100g FW)			Total carotenoids (mg/100 g FW)		
		1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean	1st s	2nd s	mean
Sulfur application													
S0		1.788	1.864	1.826	9.040	9.133	9.087	19.34	19.82	19.85	2.483	2.762	2.623
S1		2.119	2.129	2.124	9.411	9.439	9.425	20.46	20.79	20.63	2.894	2.936	2.915
LSD 5%		0.050	0.057	0.053	0.119	0.102	0.111	0.271	0.264	0.268	0.044	0.500	0.272
Fertilizers rate													
Fert.	100% CF	1.872	1.892	1.881	9.223	9.237	9.230	20.05	20.58	20.32	2.632	3.038	2.835
	50% CF+50%C	2.382	2.433	2.408	10.002	10.143	10.073	21.92	22.60	22.26	3.210	3.255	3.233
	100% C	1.607	1.665	1.636	8.433	8.478	8.456	13.58	17.73	15.79	2.225	2.253	2.239
LSD 5%		0.062	0.070	0.066	0.146	0.124	0.135	0.331	0.323	0.327	0.054	0.609	0.332
Interaction													
S0	100% CF	1.710	1.807	1.759	9.057	9.103	9.080	20.01	20.10	20.05	2.443	3.167	2.805
	50% CF+50%C	2.207	2.257	2.232	9.847	10.077	9.962	21.23	22.11	21.67	2.840	2.917	2.879
	100% C	1.447	1.530	1.489	8.217	8.220	8.219	16.80	17.07	16.94	2.167	2.203	2.185
S1	100% CF	2.033	1.977	2.005	9.390	9.370	9.380	20.00	21.08	20.54	2.820	2.910	2.865
	50% CF+50%C	2.557	2.610	2.584	10.197	10.210	10.204	22.60	22.91	22.76	3.580	3.593	3.587
	100% C	1.767	1.800	1.784	8.670	8.737	8.704	18.37	18.41	18.39	2.283	2.303	2.293
LSD 5%		0.087	0.099	0.093	0.206	0.176	0.191	0.469	0.457	0.463	0.077	0.861	0.469

S0: without sulfur; S1: with sulfur; Fert.: Fertilization; CF:chemical fertilizers; C: compost.

Biosynthesis of lycopene and other carotenoids in plants comes from mevalonic acid and AcCoA containing S-amino acid cystein. Cystein biosynthesis in plants is the first step through that inorganic S is incorporated into organic compounds and correlates significantly with availability of S for crops. It is a major reaction in the direct coupling between S and N metabolism in plant (Brunhold 1993). In addition Borguini *et al.*, (2006) confirm that tomatoes coming from organic cultivation procedures present higher vitamin C content than fruits from conventional cultivation. It was also found that fertilizer that was rich in soluble nitrogen (N) could cause a decrease in the ascorbic acid content, probably for indirect reasons, since the nitrogen supply increased the plants leaf density, which promoted shading over the fruits. In addition,Moghazy *et al.*,(2014) on pea found thatthe highest values of total sugar in fresh seeds were obtained with compost manure 2.5 ton/ fed mixed with 60 kg N/ fed inorganic nitrogen fertilizer.These results may be due to the high growth and yield of plant fertilized by nitrogen fertilizer combined with compost manure due to availability of organic nitrogen, which ultimately resulted in better root growth and increased physical activity of roots to absorb the nutrients through decomposition of organic manure that lead to increase their contents.

Oliveira *et al.*, (2013) found that tomato fruits from organic farming experienced stressing conditions that resulted in oxidative stress and the accumulation of higher concentrations of soluble solids as sugars and other compounds contributing to fruit nutritional quality such as vitamin C and phenolic compounds.

Although the color of fruits is an important consumer quality parameter, studies on carotene and contents in organic crops, have reported different results including both higher levels and lower levels when compared with conventional methods.Ilić *et al.*, (2014) found that tomatoes from organic cultivation contained more carotenoids compared to conventional cultivation, while Caris-Veyrat *et al.*,(2004) stated that tomatoes grown by the conventional or organic agricultural practices did not show any significant difference in the carotenoid content.

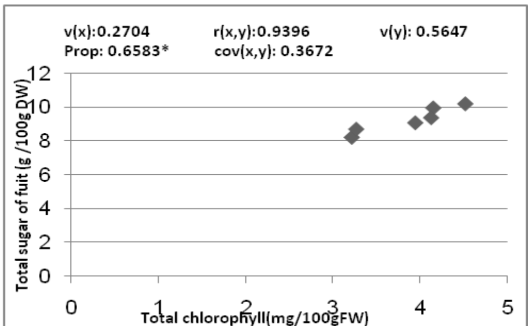
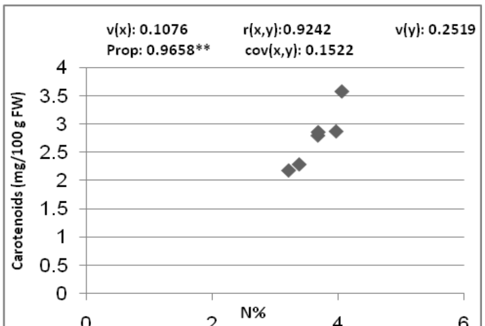


Fig (3):Correlation between leaves chlorophyll content and fruit sugar content



Fig(4):Correlation between leaves N% of and fruit caroteniod content

Economic feasibility:

The economic feasibility of husk tomato cultivation as affected by sulfur amendment to the soil and application of compost manure and mineral fertilizers during 2013 and2014 seasons are presented in Table 7. The results showed that the highest net return (16745 LE fed^{-1}) was obtained with 100% compost +sulfur, followed by 100% compost without sulfur, however, the highest benefit-cost ratio (2.190) in comparison with the other treatments was obtained with organic agricultural practice combined with sulfur. Therefore, this treatment considered economical for husk tomato production under the conditions of the present study.

Although organic cultivation produces less yield, organic crops achieve higher prices and a guaranteed placement compared to conventional one (Kapoulas *et al.,* 2011) because these products are often linked to protecting the environment and to having better quality (taste, storage), and most people believe that they are healthier.

Table (7): Economic feasibility of husk tomato cultivation as affected by compost manure, mineral fertilizers with sulfur amendment and their interactions.

Treat.	Total yield (Ton/fed)(1)	Gross return (£E/fed)(2)	Treatment cost (£E/fed) (3)	Total variablecos (£E/ fed) (4)	Net return (£E/fed) (5)	Benefitcost Rate (6)	Order
100% CF	2.523	٢٠١٨٤	4200	١٤٥٩٥	٥٥٨٩	1.383	٦
50%CF+50%c	2.615	٢٠٩٢٠	4050	١٤١٤٠	٦٤٧٥	1.416	٥
100% C	2.007	28098	3900	١٣٦٤٥	14453	2.06	٢
100% CF + S	3.050	٢٤٤٠٠	4680	١٥٠٧٥	٩٣٢٥	1.619	٣
50%CF+50%C+S	3.030	٢٤٢٤٠	4530	١٤٦٠٠	٩٣١٥	1.590	٤
100% C+S	2.205	30870	4380	١٤١٢٥	16745	2.190	١

(1) Husk tomato yield as average of two seasons,

(2) Gross return as yield (ton fed^{-1}) x 8000 £E ton^{-1}, organic yield (ton fed^{-1}) x 14000 £E ton^{-1},

(3) Treatment cost was calculated according to the following prices:Super phosphate calcium=50£E/ 50 kg, Ammoniumnitrate=150£E/ 50 kg, Ammoniumsulphate= 100 £E/ 50 kg,Potassium sulphate= 300 £E/ 50 kg, Compost manure=300£E/ ton, sulfur= 60£E / 25 kg,

(4) Total variable cost (£E fed^{-1}) including: Treatment cost plus land leasehold, transplants, labors and other agricultural practices, which equal nearly 10395 £E fed^{-1}.

(5) = (2)-(4).

(6)= (2)/ (4).

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أجريت تجربتان حقليتان في المزرعه البحثيه بالبرامون التابعه لمحطة بحوث البساتين بالمنصوره محافظة الدقهليه-مصرخلال موسمي الخريف للعامين ٢٠١٣ و ٢٠١٤ لدراسة تأثير اضافة الكبريت الزراعى(صفر- ٢٠٠ كجم/ف) للتربه مع ثلاثة مستويات من التسميد المعدنى والعضوى فى صورة كومبوست (١٠٠% أسمده معدنيه- ٥٠% أسمده معدنيه+٥٠% كومبوست – ١٠٠% كومبوست) على النمو ومحتوى النبات من الكلوروفيل و العناصر المعدنيه فضلا عن كمية المحصول وجودة الثمار لمحصول الحرنكش صنف بلدى و أستخدم لذلك تصميم القطع المنشقه. ولقد أظهرت النتائج تفوق جميع الصفات المدروسه عند اضافة الكبريت الزراعى للتربه فيما عدا عدد الأفرع و محتوى الثمار من الكاروتين فى كلا الموسمين وعدد الأوراق فى الموسم الأول حيث لم تصل الزياده فى هذه الصفات الى المعنويه عند مستوى ٥%. أيضا أدت اضافة السمادالعضوي فى صورة كومبوست بمعدل ٥٠% بالاضافه الى نصف الجرعه الموصى بها من الأسمده المعدنيه الى تحسن معنوى فى صفات النمو الخضرى و محتوى الاوراق من النتروجين، الفوسفور،البوتاسيوم والكلوروفيل وانعكس ذلك على محصول وجودة الثمار ذلك مقارنة بالزراعه العضويه والتقليديه فقط. أظهر التفاعل المشترك تفوقا في جميع الصفات المدروسه عند إضافة الكبريت الزراعى مع نصف الجرعه الموصى بها من كل من الأسمده المعدنيه والكومبوست حيث ارتفع المحصول نتيجة هذه المعامالة بنسبة ١٨.٥ و١٩% للموسمين على التوالى. ويمكن أن نخلص من خلال هذه الدراسة أن معاملة التسميد بمعدل ٥٠% من السماد المعدنى الموصى به+٥٠% من كمية الكومبوست + ٢٠٠كجم كبريت/ف كانت الأفضل للنمو و محصول الثمار الناتج ومواصفاته مع توفير ٥٠% من الكميات الموصى بها من الاسمده العضويه والمعدنيه بينما تشير دراسة الجدوى الى أنه بالرغم من انخفاض محصول الحرنكش المنتج عضويا مع اضافة الكبريت الزراعى الا انه من الناحيه الاقتصاديه كان الأكبر عائدا اقتصاديا مع تحقيق أكبر قيمة نقديه (١٦٧٤٥ ،٢.١٩٠لصافى الربح ونسبة المنافع إلى التكاليف على التوالى) بالمقارنة مع المعاملات الأخرى وذلك تحت ظروف الزراعةفي أراضي دلتاالنيل. وعليه يمكن التوصيه فى حال الزراعه بغرض الانتاج العضوى التسميد بالكومبوست بالمعدل الذى يعادل التوصيه بالسماد المعدنى للحرنكش وفى وجود الكبريت الزراعى بمعدل ٢٠٠كجم/فدان.