J. Plant Production, Mansoura Univ., Vol. 2 (12): 1741 - 1759, 2011

RESPONSE OF CAPE GOOSEBERRY PLANTS (*Physalis peruviana* L.) TO SOME ORGANIC AMENDMENTS AND FOLIAR SPRAY WITH CHITOSAN

Kamal, A. M.* and k. M. Ghanem**

*** Veget. Res. Dept., Hort. Res. Inst., Agric. Res. Center, Giza, Egypt.**

**** Dept. of Environ. and Bio Agric., Fac. Agric., Al-Azhar Univ., Cairo, Egypt.**

ABSTRACT

Two field experiments were conducted in a private farm at Al-Nubaria region, Behira Governorate, Egypt, during the successive seasons of 2009 and 2010, to study the effect of some organic manures, *i.e.,* poultry, sheep and farmyard manures as well as three concentrations of chitosan foliar treatments (0, 400 and 800 ppm) on growth, chemical composition, yield and quality of Cape gooseberry plants cv. “Balady” under an organic farming system.

The main results could be summarized as follows:

- The highest and significant values of plant height, number of branches, fresh and dry weights of Cape gooseberry plants was obtained with the addition of sheep manure combined with foliar application of chitosan at 800 ppm.
- N, P and K contents as well as total chlorophyll concentration of Cape gooseberry leaves significantly increased by the addition of sheep manure as a soil amendment combined with foliar application of chitosan at 800 ppm.
- Application of sheep manure combined with foliar spraying with chitosan at 800 ppm resulted in the highest significant values of fruit setting, number of fruits per plant, average fruit weight and total yield.
- Cape gooseberry plants, which fertilized with sheep manure combined with 800 ppm chitosan foliar application gave the highest values of reducing sugars, carotenoids, polyphenolic substances and vitamin C content of fruits, while the addition of farmyard manure combined with chitosan or without treatments (control) gave the lowest one.

This study demonstrated that it is possible to produce highest growth, yield and quality of Cape gooseberry plants by applying sheep manure as an organic amendment in combination with foliar application of chitosan at 800 ppm during the organic production system under Al-Nubaria conditions.

INTRODUCTION

Cape gooseberry (*Physalis peruviana* L.) is a very promising fruit in Egypt, because of its high nutritional value, flavor, and potential health benefits. The fruits are eaten fresh or can be prepared as a jam. Recently, the economic importance of Cape gooseberry has risen due to high acceptance for local consumption and achieving a great success in Arabic and European markets.

In recent years, there have been trend toward the use of organic vegetables that have not any harmful pesticides, herbicides, fungicides and artificial chemical fertilizers that often are present in non-organic products. Therefore, organic farms are mainly based on biological and non-chemical methods, which led to increase the using of various organic wastes.

Organic manures have a positive effect on soil acidity, soil exchange capacity and buffering the soil infiltration (Hsieh and Hsu, 1993), it contains the principal elements needed for plant growth, beside its highly water holding capacity in the soil, which reflected on increasing the vegetative growth of plants (El-Nadi *et al.,*1995). Moreover, the decomposition of organic manures due to the microorganisms enhances the slow release of nutrients to the soil, so nutrients can be adsorbed on the adsorptive sites of organic matter and soil colloids, which protects the nutrients from leaching (Yassen *et al.,* 2004).

Poultry manure has an enhancable effect on the availability of macro and micronutrients in soils *i.e*., N, P, K, Ca, Mg, Fe, Zn, Mn, and Cu; also, it reduces the fixation of such nutrients (Agbede *et al.,* 2008). Application of poultry manure improved growth and dry weight of sweet pepper plants (El-Kassas *et al.,* 1997 and Alabi, 2006). Moreover, Xu *et al.* (2000) reported that fertilization with poultry manure increases photosynthesis in tomato plants.

Sheep manure is an excellent fertilizer for the soil, providing N, P, and K (Mitchell, 1992). It has been used as a soil amendment and it is actually far better than the inorganic fertilizers because it contains large amounts of organic matter, so it feeds and builds the soil while it nourishes the plants (Giyinyu *et al.,* 2005). Addition of sheep manure improved growth and yield of many vegetable plants (Atta-Alla *et al*., 2005 on pepper; Ghorbani *et al*., 2008 and El-Tantawy, 2009 on tomato).

Naturally, growers have used farmyard manure as a common organic fertilizer to improve soil physical and chemical properties. Adding farmyard manure to the soil increases organic matter in the soil, which in turn increases the proportion of chelating of Mn, Zn and Cu in the soil to 50 %, 88 % and 98 % respectively (Mc-Grath *et al.,* 1988). Fertilization with farmyard manure increased plant dry weight, N and K contents in roots, P content in shoots, number of fruits per plant, average fruit weight, yield per plant and total yield per feddan of many vegetables plants (Muntean *et al.,*1984 on hops; Mostovoi, 1986 on pea; El-Mansi *et al.,*1999 on garlic and Nour, 2004 on pea).

Chitosan is natural polysaccharides, derived from shrimp and lobster chitin (Wojdyla, 2001). It is one of the most promising bioactive agents, which could be used in organic production systems, because of its unique biological properties, including inhibitory effect on the growth of various pathogenic fungi and its ability to stimulate the immunity of plant (Hadwiger *et al.,* 2002 and Patkowska *et al.,* 2006). Chitosan applications for crops are regulated by the EPA "U.S. Environmental Protection Agency" and the USDA "The National Organic Program" they regulates its use on organic certified farms and crops (USDA NOP and EPA, 2007). It was reported that chitosan has been used to protect tomato, cucumber, pea, melon, strawberry and lettuce against powdery and downy mildews as well as other diseases (Sharathchandra *et al.,* 2004). Chitosan application stimulates early growth stages of lettuce, soybean and upland rice (Chibu and Shibayama, 2001). It is used primarily as a natural seed treatment and plant growth enhancer (Linden *et al.,* 2000). Chitosan increases photosynthesis, promotes and enhances plant growth, stimulates nutrient uptake, increases germination and sprouting, and boosts plant vigor. When used as seed treatment or seed coating on cotton, corn, seed potatoes, soybeans, sugar beets, tomatoes, wheat and many other seeds, it elicits an innate immunity response in developing roots which destroys parasitic cyst nematodes without harming organisms (Smiley *et al.,*2002; Stoner and Linden, 2006). Agricultural applications of chitosan can reduce environmental stress due to drought and soil deficiencies, strengthen seed vitality, improve stand quality, increase yields, and reduce fruit decay of vegetables, fruits and citrus crops (Linden and Stoner, 2007).

The present work aimed to improve the productivity of Cape gooseberry plants using combinations between fertilization with different sources of organic manure amendments and foliar application of chitosan during the organic production system.

MATERIALS AND METHODS

Field experiments were conducted in a private farm at Al-Nubaria region, Behira Governorate, Egypt, during the successive seasons of 2009 and 2010, to study the effect of some organic manures in combination with foliar applications of chitosan on growth, chemical composition, yield and quality of Cape gooseberry. Table 1 shows some physical and chemical properties of the experiment soil before planting, according to the methods described by Page *et al.* (1982).

Table 1: Some physical and chemical properties of the experimental soil during 2009 and 2010 seasons.

Season	Sand (%)	Silt (%)	Clay (%)	Texture class	EC (dSm^{-1})	Organic matter (%)	pH	Ca (mg/l)	Available nutrients (ppm)		
									N	P	K
1st season	91.2	4.6	4.2	sandy	1.51	0.11	8.11	2.67	7.55	0.44	0.42
2nd season	90.7	5.2	4.1	sandy	1.94	0.08	8.31	3.11	2.44	0.54	1.51

The experiment was adopted in a split plot design with three replicates, containing nine treatments, which were the combination between three organic manures sources *i.e.* poultry manure, sheep manure and farmyard manure as well as three concentrations of chitosan foliar treatments, *i.e.,* 0, 400 and 800 ppm. Organic amendments were distributed in the main plots, whereas chitosan foliar treatments were arranged in the sub plots. The experimental unit consisted of seven ridges each of 1 m wide and 3.5 m long with an area 24.5 m^2.

On Augustus, 1st in both seasons of the study, 40 days old transplants of Cape gooseberry plants cv. “Balady” were transplanted on one side of ridges at 80 cm apart. Manures amounts were applied based on the total nitrogen percentage in dry matter of each one to provide 120 kg N per feddan. Chemical properties and the application rate of organic manures used in the experiment are shown in Tables 2 and 3. Fully decomposed organic manures were added to the soil before planting.

Table 2: Chemical properties of organic manures used in the experiment during 2009 and 2010 seasons.

Parameters	Poultry manure		Farmyard manure		Sheep manure	
	Season					
	1st	2nd	1st	2nd	1st	2nd
N (%)	2.25	2.47	1.11	1.24	2.59	2.68
P (%)	0.90	1.03	0.74	0.76	1.32	1.27
K (%)	1.35	1.46	0.95	1.01	1.72	1.65
Zn (ppm)	1.43	1.45	1.57	1.84	1.42	1.37
Mn (ppm)	5.13	5.21	3.84	4.17	5.02	5.17
Organic matter (%)	45.61	43.22	15.05	15.62	48.45	46. 42

Table 3: The quantity of organic fertilizers needed to form the total N-fertilizer as 120 Kg per fed. during 2009 and 2010 seasons..

Organic fertilizers (Kg/fed.)					
Poultry manure		Farmyard manure		Sheep manure	
1st season	2nd season	1st season	2nd season	1st season	2nd season
5333	4858	10811	9677	4762	4478

Plants were sprayed 6 times with chitosan manufactured by Chengdu Newsun Biochemistry Co., Ltd, china. Foliar application was started after two weeks from transplanting and repeated at 14 days intervals during the growth seasons using spreading agent (Super Film 1 ml/L). The untreated plants (control) were sprayed with tap water using the same spreading agent. Cape gooseberry was produced under an organic farming system, without using any of synthetic pesticides, fertilizers or herbicides.

At 108 days from transplanting, five plants were randomly taken from each plot for determining the vegetative growth parameters, *i.e*., plant height, number of branches, fresh and dry weights per plant foliage. Ten days after the last foliar treatment representative samples from the fourth upper leaves were taken to determinate chlorophyll content (SPAD units), using a portable leaf chlorophyll meter (Minolta Model SPAD 501) according to Murquard and Timpton (1987). Dry matter of shoots was used to determine the content of nitrogen percentage according to the methods described by Bremner and Mulvaney (1982). Phosphorus percentage was estimated colorimetrically according to Olsen and Sommers (1982). In addition, Potassium percentage was determined flame photometrically as described by Jackson (1967). Five uniform plants from each plot were randomly chosen, labeled to determinate fruits setting percentage. All harvested fruits from each plot were used for the determination of number of fruits per plant, average fruit weight and total yield ton per feddan.

A representative sample of 50 fruits from each experimental plot at the ripe stage were taken at the middle of harvesting seasons for determining the following quality characteristics of Cape gooseberry fruits. Reducing sugars were determined colorimetrically as described by Michel *et al*. (1956). Total Carotenoids content was determined in acetone extract and measured colorimetrically according to the method of AOAC (1990). Total polyphenolic substances were measured (as tannic acid) colorimetrically by the Folin-Ciocalteu according to the method of Doka and Bicanic (2002). Vitamin C was estimated by the colorimetric method of Folin-Ciocalteu according to Bajaj and Kaur (1981).

The obtained data were subjected to statistical analysis according to Gomez and Gomez (1984). Means separation was done to compare between means using the least significant difference (LSD) at *P* ≤0.05.

RESULTS AND DISCUSSION

Vegetative growth characteristics.

Effect of organic manure amendments.

Data in Table 4 indicate clearly that there were significant differences among the used organic manures on the studied vegetative growth characters expressed as plant height, number of branches, fresh and dry weights. The differences reached the highest significant values in all of the studied traits with the addition of sheep manure followed by poultry manure in comparison with the addition of farmyard manure, during both seasons of the study. The results are coincided with those of Atta-Alla *et al.* (2005) who found that application of sheep manure compared with farmyard and poultry manures significantly increased plant height, number of branches as well as fresh and dry weight of leaves, branches and roots of pepper plants. Moreover, El-Tantawy (2009) mentioned that fertilization with goat manure increased tomato plants height, number of branches, number of leaves, fresh and dry weight in comparison with application of farmyard manure.

Table 4: Vegetative growth characteristics of 108 days old Cape gooseberry plants as affected by organic manure sources during 2009 and 2010 seasons.

Organic manure sources	2009				2010			
	Plant height (cm)	Branches No.	Plant fresh Wt. (g)	Plant dry Wt. (g)	Plant height (cm)	Branches No.	Plant fresh Wt. (g)	Plant dry Wt. (g)
Poultry	72.7	15.4	800.6	133.8	79.1	15.7	805.7	127.2
Sheep	77.3	16.3	842.1	145.2	86.4	17.0	836.7	136.1
Farmyard	70.0	15.1	774.7	125.8	75.1	14.9	788.5	120.9
LSD at P ≤0.05	4.1	0.8	45.57	8.04	3.9	1.00	NS	7.5

The superior effect of sheep manure compared with poultry and farmyard manures on enhancing plant growth parameters are mainly due to the relatively high contents of organic matter, essential macro and micronutrients (Table 2). Moreover, the high N-content of sheep manure is closely related with enhancing vegetative growth throw the increases of the carbohydrates and protein synthesis and this in turn enhances dry matter accumulation (Edmond *et al.,* 1981; Reddy and Reddi, 1998). In addition, the high organic matter of sheep manure (Table 2) increases the organic matter input in the experiment soil that affect on soil properties and consequently, plant can depend on mineral nutrients supply (Chirinda *et al.,* 2008). Moreover, the increment in plant growth due to application of sheep manure may be ascribed to reducing in soil bulk density, increase porosity and moisture content as well as higher availability of macro and micronutrients in soils *i.e.*, N, P, K, Ca, Mg, Fe, Zn, Mn, and Cu as well as reducing of the fixation process of those nutrients (Agbede *et al.,* 2008).

Effect of foliar application of chitosan.

Data in Table 5 show that all foliar application of chitosan had a significant effect on all studied vegetative growth characters, *i.e.,* plant height, number of branches, fresh and dry weights. It is evident clear that the most effective treatment was that of the highest chitosan concentration (800 ppm) compared with control in both seasons. These results were in conformity with those obtained by Farouk *et al.* (2008) who found that foliar spraying of chitosan at 0.050% significantly increased cucumber plant height, number of branches, shoot dry weight and plant leaves area. Also, El-Tantawy (2009) demonstrated that spaying tomato plants with chitosan increased plant height, number of branches, number of leaves, fresh and dry weight of roots, branches, and leaves and as well as total fresh and dry weight of plant. Ghoname *et al.* (2010) on sweet pepper and Abdel-Mawgoud (2010) on strawberry came to similar results.

Table 5: Vegetative growth characteristics of 108 days old Cape gooseberry plants as affected by chitosan concentrations during 2009 and 2010 seasons.

Chitosan concentrations	2009				2010			
	Plant height (cm)	Branches No.	Plant fresh Wt. (g)	Plant dry Wt. (g)	Plant height (cm)	Branches No.	Plant fresh Wt. (g)	Plant dry Wt. (g)
Control	64.4	14.6	766.7	126.8	77.9	15.4	796.3	124.4
400 ppm	76.1	15.5	802.5	134.1	79.0	15.9	797.1	125.7
800 ppm	79.5	16.6	848.3	144.0	83.8	16.2	837.5	134.2
LSD at P ≤0.05	3.0	0.8	37.28	NS	4.2	NS	35.78	8.5

The remarkable increases in growth parameters as a result of foliar application of chitosan may be attributed to one or more of the following; 1) its effect on many plant physiological processes such as cell elongation, cell division, enzymatic activation and protein synthesis (Farouk *et al.,* 2008), 2) chitosan significantly increases accumulation of organic compounds as Proline, which plays an important role in osmotic adjustment of plant cell (Watanabe *et al.,*2000 and Guan *et al.,*2009), 3) chitosan reduces lipid peroxidation through increasing antioxidative enzymes and consequently, reduce the level of free radicals (Meloni *et al.,* 2003), 4) chitosan can protect plant cell membrane from damage (Wise, 1995) and hence, retarding or avoiding cells injury (Hu *et al.,*2006), the antimicrobial effect of chitosan on foliar pathogenesis and microparasitic fungi (Farouk *et al.,*2008 and Palma-Guerrero *et al.,*2008).

Interaction between organic manure amendments and foliar application of chitosan.

Results in Table 6 show that all the studied morphological characters were significantly affected due to the interaction treatments. In this respect, the highest significant values of plant height, number of branches, fresh and dry weight were obtained with the addition of sheep manure combined with foliar application of chitosan at 800 ppm. Meanwhile, the amendment of poultry manure combined with foliar spraying of chitosan at 800 ppm came in the second rank. These results are in harmony with those of El-Tantawy (2009) who reported that spraying tomato plants with chitosan combined with fertilization by goat manure resulted in the highest number of branches, number of leaves and plant fresh weight in comparison with fertilization by farmyard manure.

Table 6: Vegetative growth characteristics of 108 days old Cape gooseberry plants as affected by the interaction between organic manure sources and chitosan concentrations during 2009 and 2010 seasons.

Treatments		2009				2010			
Organic manure sources	Chitosan concentrations	Plant height (cm)	Branches No.	Plant fresh Wt. (g)	Plant dry Wt. (g)	Plant height (cm)	Branches No.	Plant fresh Wt. (g)	Plant dry Wt. (g)
Poultry	Control	63.1	14.3	777.8	129.4	75.8	15.4	795.6	125.0
	400 ppm	75.6	15.2	801.3	134.1	77.1	15.7	788.6	124.7
	800 ppm	79.4	16.8	822.9	138.0	84.5	16.0	832.9	131.9
Sheep	Control	68.3	15.7	769.9	129.7	84.2	16.2	814.2	129.6
	400 ppm	78.6	15.8	838.2	144.3	85.1	16.8	825.9	134.2
	800 ppm	85.1	17.3	918.4	161.7	89.8	17.9	870.2	144.7
Farmyard	Control	61.8	14.0	752.4	121.2	73.6	14.7	779.2	118.6
	400 ppm	74.2	15.4	768.1	123.9	74.6	15.1	776.9	118.3
	800 ppm	74.1	15.8	803.7	132.4	77.2	14.8	809.6	126.0
LSD at $P \leq 0.05$		3.6	0.7	39.5	9.8	3.2	0.9	46.5	8.2

Chemical composition of plant foliage.

Effect of organic manure amendments.

Data in Table 7 declare that the addition of sheep manure compared with poultry or farmyard manure significantly affected N, P, K and total chlorophyll contents of plant foliage in both seasons. The exception was that of P content during first season and K content during second one, which did not reach to the significant level. Similar findings were demonstrated by Atta-Alla *et al. (*2005) who found that fertilization of pepper plants with sheep manure increased N, P, K and total carbohydrates in the dry leaves. Moreover, El-Tantawy (2009) reported that fertilization of tomato plants with goat manure increased chlorophyll a, chlorophyll b, total chlorophyll and carotenoids.

Table 7: Chemical composition of Cape gooseberry foliage as affected by organic manure sources during 2009 and 2010 seasons.

Organic manure sources	2009				2010			
	N (%)	P (%)	K (%)	Total chlorophyll (SPAD units)	N (%)	P (%)	K (%)	Total chlorophyll (SPAD units)
Poultry	3.27	0.287	3.19	41.47	3.19	0.317	2.98	42.83
Sheep	3.42	0.306	3.40	44.24	3.40	0.336	3.11	46.46
Farmyard	3.17	0.276	3.06	39.82	3.06	0.305	2.91	41.45
LSD at $P \leq 0.05$	0.12	NS	0.17	2.01	0.171	0.016	NS	2.14

The chemical composition of sheep manure may explain its superior effect on improving chemical composition of Cape gooseberry foliage than poultry or farmyard manure, it has a high contents of N, P and K as a main macro nutrients than both of poultry and farmyard manures, it is also contains a remarkable percentage of organic matter (Table 2), that in turn extends to plant contents of these nutrients and chlorophyll. On the other hand, it was reported that poultry manure is characterized by the fast complete decomposition of organic matter (Awad *et al.,* 2003), that may led to fast leaching of nutrients especially in sandy soil, like our experimental condition.

Effect of foliar application of chitosan.

Data presented in Table 8 indicate that using chitosan as foliar application at 800 ppm was the most effective treatment in increasing N, P , K and total chlorophyll contents of Cape gooseberry plants, meanwhile, the lowest value was obtained from control plants in both seasons. Similar results were obtained by Farouk *et al. (*2008); they found that foliar application of chitosan at 0.050% increases photosynthetic pigments in cucumber leaves. Moreover, spraying tomato plants with chitosan significantly induces chlorophyll a, chlorophyll b, total chlorophyll and carotenoids (El-Tantawy, 2009). The present results are confirmed with those obtained by Ghoname *et al. (*2010) on chitosan treated sweet pepper plants; they recorded the highest significant content of P and K in the leaves.

The positive effect of chitosan on N, P and K as well as chlorophyll contents may be attributed to its effect on enhancing ion uptake (Farouk *et al.,*2008), promoting roots system (Gornik *et al.,* 2008) and stimulating pigmentation as well as enhancing the efficacy of photosynthetic apparatus (Amaresh and Bhatt, 1998).

Table 8: Chemical composition of Cape gooseberry foliage as affected by chitosan concentrations during 2009 and 2010 seasons.

Chitosan concentrations	2009				2010			
	N (%)	P (%)	K (%)	Total chlorophyll (SPAD units)	N (%)	P (%)	K (%)	Total chlorophyll (SPAD units)
Control	3.10	0.273	3.04	39.48	3.60	0.300	0.30	40.78
400 ppm	3.27	0.286	3.18	41.34	3.81	0.318	0.32	43.36
800 ppm	3.49	0.309	3.44	44.72	4.08	0.340	0.34	46.60
LSD at *P* ≤0.05	0.12	0.012	0.13	1.51	0.16	0.017	0.02	2.08

Interaction between organic manure amendments and foliar application of chitosan

Data presented in Table 9 indicated that N, P, K as well as total chlorophyll content of Cape gooseberry leaves are significantly affected by the interaction treatments. The highest significant values are obtained by with sheep manure combined with foliar application of chitosan at 800 ppm. It is also clear that the lowest values were obtained by the addition of farmyard manure without chitosan. Such results were confirmed on tomato by the findings of El-Tantawy (2009) who found that the highest concentration of photosynthetic pigments (chlorophyll and carotenoids) are achieved by the combined application of goat manure and spraying with chitosan.

Table 9: Chemical composition of Cape gooseberry foliage as affected by the interaction between organic manure sources and chitosan concentrations during 2009 and 2010 seasons.

Treatments		2009				2010			
Organic manure sources	Chitosan concentrations	N (%)	P (%)	K (%)	Total chlorophyll (SPAD units)	N (%)	P (%)	K (%)	Total chlorophyll (SPAD units)
Poultry	Control	3.08	0.271	3.01	39.13	3.54	0.295	2.83	40.11
	400 ppm	3.24	0.284	3.16	41.08	3.79	0.316	2.95	43.03
	800 ppm	3.49	0.306	3.40	44.20	4.08	0.340	3.17	45.36
Sheep	Control	3.19	0.289	3.21	41.73	3.81	0.318	2.9	43.83
	400 ppm	3.39	0.299	3.32	43.16	3.99	0.333	3.08	45.35
	800 ppm	3.69	0.331	3.68	47.84	4.29	0.358	3.35	50.2
Farmyard	Control	3.02	0.260	2.89	37.57	3.45	0.288	2.75	38.39
	400 ppm	3.19	0.275	3.06	39.78	3.65	0.304	2.90	41.71
	800 ppm	3.30	0.292	3.24	42.12	3.87	0.323	3.08	44.24
LSD at *P* ≤0.05		0.16	0.021	0.18	2.11	0.17	0.016	0.19	3.04

Yield and its components

Effect of organic manure amendments.

Data in Table 10 represent the yield parameters of Cape gooseberry as affected by different organic fertilizers. It is clear that both poultry manure and farmyard manure came in the second rank after sheep manure which gave the highest significant promotion effect for yield parameters , *i.e.,* fruit setting, number of fruits per plant, average fruit weight and total yield per feddan. However, the increments did not reach the level of significant with respect to the average of fruit weight during first season as well as fruit setting and number of fruits per plant during the second one of the present work.

Table 10: Yield characteristic of Cape gooseberry as affected by organic manure sources during 2009 and 2010 seasons.

Organic manure sources	2009				2010			
	Fruits setting (%)	Fruits No./plant	Average fruit Wt. (g)	Total yield (ton/fed)	Fruits setting (%)	Fruits No./plant	Average fruit Wt. (g)	Total yield (ton/fed)
Poultry	45.53	157.6	3.09	2.39	51.15	178.2	3.45	2.57
Sheep	49.27	161.8	3.22	2.61	52.69	181.8	3.59	2.87
Farmyard	43.20	157.6	3.01	2.27	51.20	177.0	3.38	2.48
LSD at $P \leq 0.05$	2.33	3.1	NS	0.17	NS	NS	0.13	0.20

The increment in yield parameters of Cape gooseberry plants as affected by sheep manure amendments might be due to the increase in plant growth parameters (Table 4), plant foliage nutrient and chlorophyll contents (Table 7), nevertheless, obtained results also can be explained in the light of facts that addition of sheep manure to the soil increases photo assimilation of tomato plants (Azarmi *et al.,*2008) this may be lead to increase the dry matter accumulation and this may be positively reflects on the weight of fruits per plant and total yield.

These yield enhancements due to sheep manure application are in agreement with the results obtained by Muniz *et al.* (1989) and Atta-Alla *et al.* (2005); they reported that fertilization of pepper plants with sheep manure increased number of fruits and total yield over both of farmyard and poultry manures. Moreover, Ghorbani *et al.* (2008) compared different organic manures sources, *i.e*., cattle, sheep and poultry manures on tomato, they found that addition of sheep manure led to the highest total tomato yield. These results were supported by Ghorbani *et al.* (2008) and El-Tantawy (2009) on tomato.

Effect of foliar application of chitosan.

Data in Table 11 show that increasing the concentration of sprayed chitosan up to 800 ppm significantly increased average fruit weight. Meanwhile, fruit setting, number of fruits and total yield were increased but not significantly. The same trend was noticed in the two seasons and agreed with those obtained by Walker *et al.* (2004), El-Tantawy (2009) and Borkowski *et al.* (2007) on tomato. Moreover, Farouk *et al. (*2008) on cucumber, Ghoname *et al.* (2010) on sweet pepper and Abdel-Mawgoud

(2010) on strawberry they found a stimulatory effect of chitosan on yield parameters (number and average weight of fruits and total fruits yield).

The significant increases in fruit weight as a result of foliar application with chitosan may be due to the stimulation of chitosan to the translocation of the photoassimilates (Chibu and Shibayama, 2001; Farouk *et al.,* 2008). Furthermore, chitosan led to a significant increment in photosynthetic pigments (Table 7) which led to the increment in dry matter accumulation that reflected on the average fruit weight. The present results are confirmed with Farouk *et al.* (2008).

Table 11: Yield characteristic of Cape gooseberry as affected by chitosan concentrations during 2009 and 2010 seasons.

Chitosan concentrations	2009				2010			
	Fruits setting (%)	Fruits No./plant	Average fruit Wt. (g)	Total yield (ton/fed)	Fruits setting (%)	Fruits No./plant	Average fruit Wt. (g)	Total yield (ton/fed)
Control	44.84	157.8	3.04	2.35	51.71	177.7	3.41	2.54
400 ppm	46.07	159.2	3.05	2.38	50.09	179.6	3.42	2.59
800 ppm	47.09	160.0	3.23	2.53	53.24	179.8	3.59	2.78
LSD at $P \leq 0.05$	NS	NS	0.17	NS	NS	NS	0.154	NS

Interaction between organic manure amendment and foliar application of chitosan.

The Interaction between organic manure amendments and chitosan foliar application showed a significant effect on Cape gooseberry yield (Table 12), it is clear that application of sheep manure in combined with foliar spraying with chitosan at 800 ppm resulted in the highest significant values of fruit setting, number of fruits per plant, average fruit weight and total yield, the unique exception was that of fruit setting which did not show any significant response in the second season of this work. The results are in agreement with those of El-Tantawy (2009) who mentioned that application of goat manure and spraying with chitosan stimulated tomato fruit yield.

Fruit quality characteristics

Effect of organic manure amendments.

According to Table 13, the addition of sheep manure record the highest significant fruit content of reducing sugars (in both seasons) and polyphenolic contents (1st season). It is also clear that not all the used organic manures showed any significant effect on carotenoids and vitamin C contents of Cape gooseberry fruits during the both growing seasons.

Table 12: Yield characteristic Cape gooseberry as affected by the interaction between organic manure sources and chitosan concentrations during 2009 and 2010 seasons.

Treatments		2009				2010			
Organic manure sources	Chitosan concentrations	Fruits setting (%)	Fruits No./plant	Average fruit Wt. (g)	Total yield (ton/fed)	Fruits setting (%)	Fruits No./plant	Average fruit Wt. (g)	Total yield (ton/fed)
Poultry	Control	44.71	156	3.01	2.29	51.23	176.5	3.41	2.47
	400 ppm	45.48	157.1	3.07	2.33	50.1	178.8	3.38	2.52
	800 ppm	46.39	159.7	3.18	2.55	52.12	179.4	3.57	2.71
Sheep	Control	47.03	161.1	3.15	2.54	52.84	181	3.49	2.75
	400 ppm	48.88	161.6	3.11	2.57	50.92	181.6	3.54	2.81
	800 ppm	51.89	162.8	3.41	2.71	54.3	182.9	3.73	3.04
Farmyard	Control	42.77	156.3	2.97	2.22	51.05	175.6	3.34	2.41
	400 ppm	43.84	158.9	2.96	2.25	49.26	178.5	3.33	2.43
	800 ppm	42.99	157.5	3.09	2.33	53.3	177	3.47	2.59
LSD at $P \leq 0.05$		2.48	3.87	0.181	0.19	NS	3.67	0.194	0.184

Table 13: Quality characteristics of Cape gooseberry fruits as affected by organic manure sources during 2009 and 2010 seasons.

Organic manure sources	2009				2010			
	Reducing sugars (%)	Carotenoids (µg/mL)	Polyphenolic substances (mg/100mL)	Vitamin C (mg/100mL)	Reducing sugars (%)	Carotenoids (µg/mL)	Polyphenolic substances (mg/100mL)	Vitamin C (mg/100mL)
Poultry	43.62	43.51	78.30	20.79	49.61	45.1	72.80	22.29
Sheep	46.61	43.11	83.53	21.70	52.92	43.93	73.98	23.11
Farmyard	42.21	42.50	75.18	20.01	47.63	43.71	73.89	21.87
LSD at ≤0.05	3.41	NS	4.14	NS	2.67	NS	NS	NS

The above mentioned significant effect of sheep manure addition on Cape gooseberry fruit content of reducing sugars in comparison with the addition of other used organic manures may be attributed to the high K-content of sheep manure (Table 2) and the significant absorption of that nutrient (Table 7) by Cape gooseberry plants, since potassium plays an important role in water status of plant, promoting the translocation of newly synthesized photosynthesis and mobilization of stored materials as well as promoting the synthesis of sugars and polysaccharides (Mengel and Kirkby, 1982). Moreover, it was reported that there was a relationship between photosynthesis and phenolic biosynthesis (Kefeli *et al.,* 2003). In this respect, the addition of organic manures has an enhancable effect on photosynthesis of tomato plants (Xu *et al.,* 2000) that in turn, allowing sufficient metabolites supply from photosynthetic sources and consequently enhanced polyphenolic contents of Cape gooseberry fruits. On the other hand, Azarmi *et al.* (2008) and El-Tantawy (2009) found that addition of sheep manure or farmyard manure to the soil had no significant effect on tomato fruit quality as TSS and pH of juice.

Effect of foliar application of chitosan.

It was obvious from data in Table 14 that increasing concentration of sprayed chitosan up to 800 ppm greatly improved all Cape gooseberry fruits quality characters, *i.e.,* reducing sugars, carotenoids, polyphenolic substances and vitamin C contents than those of control in the two seasons. The results were in the same trend in the two seasons and in agreement with those obtained by Ghoname *et al.* (2010) who found that spraying sweet pepper plants with chitosan showed positive responses on total soluble solids, total acidity and vitamin C content of fruits. Similarly, ascorbic acid, carbohydrate, protein, potassium and phosphorus content of cucumber fruits (Farouk *et al.,*2008) and strawberry fruits (Abdel-Mawgoud, 2010) were significantly enhanced by the foliar application of chitosan (0.05%).

The pronounced promotional effect of chitosan on reducing sugars, carotenoids, polyphenolic substances and vitamin C content of Cape gooseberry fruits compared with control could be due to the enhancable nature of chitosan on photosynthesis process (Khan *et al.,* 2002) that strongly correlated with the synthesis of sugars, polysaccharides and vitamins. Moreover, chitosan is involved in the biosynthesis of phenolic substances in plant (Kefeli *et al.,* 2003). In addition, application of chitosan encourages phenolic substances accumulation (Bautista-Banos, 2006) that in turn reflected in the polyphenolic substances contents of Cape gooseberry fruits.

Table 14: Quality characteristics of Cape gooseberry fruits as affected by chitosan concentrations during 2009 and 2010 seasons.

Chitosan concentrations	2009				2010			
	Reducing sugars (%)	Carotenoids (µg/mL)	Polyphenolic substances (mg/100mL)	Vitamin C (mg/100mL)	Reducing sugars (%)	Carotenoids (µg/mL)	Polyphenolic substances (mg/100mL)	Vitamin C (mg/100mL)
Control	40.85	42.85	74.53	20.04	47.22	43.84	71.81	21.68
400 ppm	44.14	42.92	78.05	20.49	49.45	44.34	72.99	22.22
800 ppm	47.45	43.34	84.43	21.96	53.49	44.57	75.88	23.37
LSD at ≤0.05	3.11	NS	3.07	NS	2.07	NS	2.31	NS

Interaction between organic manure amendments and foliar application of chitosan.

Data in Table 15 show that Cape gooseberry plants which fertilized with sheep manure combined with 800 ppm chitosan foliar application gave the highest values of reducing sugars, carotenoids, polyphenolic substances and vitamin C content of fruits, while the addition of farmyard manure combined with chitosan control treatment (0 ppm) gave the lowest one. In contrary, El-Tantawy (2009) reported that fertilization of tomato plants with goat manure combined with foliar spraying of chitosan showed no significant effect on pH and TSS of tomato fruits, the results were the same at the two seasons.

The improving effect of such treatment on Cape gooseberry fruits quality could be expected since such treatment promoted vegetative growth (Table 6) and increased N, P, K and chlorophyll content (Table 9) of plant foliage.

In conclusion, this study demonstrated that it is possible to produce highest growth, yield and quality of Cape gooseberry plants by applying sheep manure as an organic amendment in combination with foliar application of chitosan at 800 ppm under the organic production system.

Table 15: Quality characteristics of Cape gooseberry fruits as affected by the interaction between organic manure sources and chitosan concentrations during 2009 and 2010 seasons.

Treatments		2009				2010			
Organic manure sources	**Chitosan concentrations**	**Reducing sugars (%)**	**Carotenoids (µg/mL)**	**Polyphenolic substances (mg/100mL)**	**Vitamin C (mg/100mL)**	**Reducing sugars (%)**	**Carotenoids (µg/mL)**	**Polyphenolic substances (mg/100mL)**	**Vitamin C (mg/100mL)**
Poultry	Control	39.82	42.5	73.88	20.03	46.81	44.89	70.74	21.03
	400 ppm	43.83	43.36	77.56	20.39	49.14	44.62	72.45	22.08
	800 ppm	47.22	44.68	83.45	21.94	52.87	45.80	75.21	23.76
Sheep	Control	42.60	43.59	78.79	20.52	49.92	43.90	71.74	22.43
	400 ppm	46.14	43.65	81.49	21.48	51.63	44.50	73.19	23.20
	800 ppm	51.08	42.08	90.32	23.10	57.22	43.40	77.02	23.71
Farmyard	Control	40.12	42.47	70.93	19.58	44.94	42.73	72.96	21.59
	400 ppm	42.44	41.76	75.10	19.61	47.58	43.90	73.32	21.38
	800 ppm	44.06	43.27	79.52	20.84	50.38	44.50	75.40	22.64
LSD at $P \leq 0.05$		2.45	NS	4.11	1.44	2.37	NS	2.88	NS

REFERENCES

Abdel-Mawgoud, A. M. R. (2010). Growth and yield responses of strawberry plants to chitosan application European J. Scientific Res., 39(1):161-168.

Agbede, T. M; S. O. Ojeniyi and A. I. Adeyemo (2008). Effect of poultry manure soil physical and chemical properties, growth and grain yield of sorghum in Southern, Nigeria. Am. Eurasian I. Sustainable Agtic., 2:72-77.

Alabi, D. A. (2006). Effects of fertilizer phosphorus and poultry droppings treatments on growth and nutrient components of pepper (*Capsicum annuum* L.) African J. Biotech., 5(8):671-677.
Amaresh, C. and R. K. Bhatt (1998). Biochemical and physiological response to salicylic acid in reaction to systemic acquired resistance. Photosynth., 35(2): 255-258.
AOAC (1990). Official Methods of Analysis. 10th Association of Official Analytical Chemists. Inc. USA.
Atta-Alla, H.; A. K.Waly; A. M. Khaleil and E. Elazony (2005). Effect of some organic manures on the vegetative growth, fruits chemical components of *Capsicum annuum* L. var. Santoka. The 6th Arabian Conference for Horticulture, Ismailia, Egypt, 370-378.
Awad, Y. H.; H. A. Ahmed and O. F. EL-Sedfy (2003). Some chemical properties and NPK availability of sandy soil and yield productivity as affected by some soil organic amendments. Egypt. J. Appl. Scie., 18(2):356-365.
Azarmi, R.; P. S. Ziveh and M. R. Satari (2008). Effect of vermicompost on growth, yield and nutrition status of tomato (*Lycopersicum esculentum*). Pak. J. Biol, Sci., 11:1797-1802.
Bajaj, K. L. and G. Kaur (1981). Spectrophotometric determination of total ascorbic acid in vegetables and fruits. Analyst., 106:117-120.
Bautista-Banos, S.; A. N. Hernández-Lauzardo; V. M. G. Velázquez-del; M. Hernández-López; B. E. Ait; E. Bosquez-Molina and C. L. Wilson (2006). Chitosan as a potential natural compound to control pre and postharvest diseases of horticultural commodities. Crop Protection, 25:108-118.
Borkowski, J.; B. Dyki; A. Felczyńska and W. Kowalczyk (2007). Effect of biochiikol 20 PC (chitosan) on the plant growth, fruit, teild and healthiness of tomato plants and stems. Polish Chitin Society, Monograph XII. (C.F. Computer Search).
Bremner, J. M. and C. S. Mulvaney (1982). Total nitrogen. In: Page, A. L.; R. H. Miller and D. R. Keeney (Eds). Methods of Soil Analysis. Part 2, Amer., Soc., Agron., Madison, W I. USA, 595- 624.
Chibu, H. and H. Shibayama (2001). Effects of chitosan applications on the growth of several crops, *in*: *T. uragami*; *K. kurita*; *T. fukamizo* (Eds.), Chitin and chitosan in Life Science Yamaguchi, 235–239.
Chirinda, N.; I. E. Olesen and J. R. Porter (2008). Effect of organic matter input on soil microbial properties and crop yields conventional and organic cropping system. Proceedings of the 16th IFOAM Organic World Congress, Jun. 6-20, Modena, Italy. (C.F. Computer Search).
Doka, O. and D. Bicanic (2002). Determination of total polyphenolic content in red wines by means of the Folin-Ciocalteu Colour-imetry Assay. Anal. Chem., 74:2157-2161.
Edmond, J. B.; T. L. Senn; F. S. Znderws and R. G. Halfacre (1981). Fundamentals of Horticulture, Published by Tata Mc-Graw-Hill Publishing Co., Limited, Indian.

El-Kassas, H. I.; A. F. Abou-Hadid and N. M. H. Eissa (1997). Effect of different organic manures on the yield and elemental composition of sweet pepper plants grown on sandy soil. Egypt. J. Appl. Sci., 12(3):262-281.

El-Mansi, A. A.; A. Bardisi; A. N. Fayed and E. E. Abou El-Khair (2004). Effect of water quality and Farmyard manure on garlic under sandy soil conditions I. Dry weight and plant chemical composition. Zagazig J. Agric. Res., 31 (2):523-547.

El-Nadi, A. H; R. K. Rabie; R. E. A. Abdel-Magid and S. I. Abdel-Aal (1995). Chemical, physics-chemical and microbiological examination of town refuses compost and chicken manure as organic fertilizers. J. Arid Environments, 30:107-113.

El-Tantawy, E. M. (2009). Behavior of tomato plants as affected by spraying with chitosan and aminofort as natural stimulator substances under application of soil organic amendments. Pakistan J. Biol. Sci., 12(17):1164-1173.

Farouk, S.; K. M. Ghoneem and A. A. Ali (2008). Induction and Expression of Systemic Resistance to Downy Mildew Disease in Cucumber by Elicitors Egypt. J. Phytopathol., 36(1-2):95-111.

Ghoname, A. A; M. A. El-Nemr; A. M. R Abdel-Mawgoud and W. A. El-Tohamy (2010). Enhancement of Sweet Pepper crop growth and production by application of biological, organic and nutritional solutions. Research j. Agric. Bio. Sci., 6(3):349-355.

Ghorbani R.; A. Koocheki; M. Jahan and G. A. Asadi (2008). Impact of organic amendments and compost extracts on tomato production and storability in agro ecological systems. Agron., Sustain., 28:307-311.

Giyinyu, B. M.; S. O. Ahonsi and M. Barau (2005). Effects of different types of organic manure on growth and yield of tomato var. VFN. Proceedings of the 1st National Conference on organic Agriculture in Nigeria held. University of Agriculture, Abeokuta, Nigeria. 25th to 28th October.

Gomez, K. A. and A. A. Gomez (1984). Statistical procedures for agricultural research, John Wiley and Sons, NY, USA.

Gornik, K.; M. Grzesik and B. Romanowska-Duda (2008). The effect of chitosan on rooting of grapevine cuttings and on subsequent plant growth under drought and temperature stress. I. Fruit Ornamental Plant Res., 16:333-343.

Guan Y.; J. Hu; X. Wang and C. Shao (2009). Seed priming with chitosan improves maize germination and seedling growth in relation to physiological changes under low temperature stress. J. Zhejiang, Univ., Sci., B. 10(6):427-433.

Hadwiger, L. A.; S. I. Klosterman and I. J. Choi (2002). The mode of action of chitosan and Oligomers in inducing plant promoters and developing disease resistance in plant. In: Advances in Chitin Sciences, Suchiva, K., S. Chandkrachang, P. Methacanon and M. G. Peter (Eds.). Hulalongkorn University, Bangkok, Thailand, 5: 452-457. (C.F. Computer Search).

Hsieh, C. F. and K. H. Hsu (1993). An experiment on the organic farming of sweet corn and vegetable soybeans. Bulletin of Taichung District Agricultural Improvement Station, 39:59-84.

Hu, J.; X. J. Xie; Z. F. Wang and W. J. Song (2006). Sand priming improves germination and growth of alfalfa under high-salt concentration stress. Seed Science and Technology. 34(1):199-204.

Jackson, M. L. (1967). Soil Chemical Analysis. Prentic Hall of Indian Private Limited, New Delhi.

Kefeli V. I.; M. V. Kalevitch and B. Borsari (2003). Phenolic cycle in plants and environment J. Cell and Molecular Biology, 2:13-18.

Khan, W. M.; B. Prithiviraj and D. L. Smiyh (2002). Effect of foliar application of chitin oligosaccharides on photosynthesis of maize and soybean. Photosynthetica, 40:621-624.

Linden, J.; R. Stoner; K. Knutson and C. Gardner-Hughes (2000). Organic Disease Control Elicitors. Agro Food Industry Hi-Te, 12-15.

Linden, J. C. and R. J. Stoner (2007). Pre-harvest application of proprietary elicitor delays fruit senescence. A. Ramina *et al*., (Eds.). Advances in Plant Ethylene Research: Proceedings of the 7th International Symposium on the Plant Hormone Ethylene. 301-302. Springer: Dordrecht, the Netherlands. (C.F. Computer Search).

Mc-Grath, S. P.; J. R. Sanders and M. H. Shalaby (1988). The effect of soil organic matter levels on soil solution concentrations and extractabilities of manganese , zinc and copper, Geoderma. (42):178.

Meloni, D. A.; M. A. Oliva; C. A. Martinez and J. Cambraia (2003). Photosynthesis and activity of superoxide dismutase, peroxidase and glutathione reductase in cotton under salt stress. Environmental and Experimental Botany, 49(1):69-76.

Mengel, K. and E. A. Kirkby (1982). Textbook of principles of plant nutrition. 3rd ed. P. 655. International Potash Institute, Bern, Switzerland. (C.F. Computer Search).

Michel, K. A.; J. K. Gilles ; R. P. A. Ramilton and F. Smith (1956). Colorimetric method for determination of sugars and related substances. Annal Chem., 28(3):350-356.

Mitchell, C. (1992). Using livestock manure as fertilizer. Extension Agronomist, Agronomy, Auburn University. (C.F. Computer Search).

Mostovoi, M.I. (1986). Effect of organic and mineral fertilizers on yield and fooder pea quality under irrigation .Agokhimija, 11:68-72. (C.F. Maize-Abstr., 4:1465).

Muniz, J. L.; L. Da-Silva and L. Da-Silva (1989). Capsicum cultivars under organic and chemical fertilization. Comunicado Tecnico, Empresa, de-Pesquisa. Agropecuaria, Do-Ceara, (25):7.

Muntean, L.; A. Salontai; S. Cerrea; A. Tapalaga; F. vaida; V. Carean; V. Vals and O. Kapros (1984). Results of experiments with green manures for hops. *Lucrarile Seminarului* Culture Hameiulni in Romania IV.117-125 (C.F. Hort. Abstrs. 56:534).

Murquard, R. D. and J. L. Timpton (1987). Relationship between extractable chlorophyll and an insitu method to estimate leaf green. Hort. Sci., 22(6):1327.

Nour, E. M. E. (2004). Physiological studies on pea crop under sandy soil conditions. Ph. D. Thesis, Fac. Agric., Zagazig University, Egypt.

Olsen, S. R. and L. E. Sommers (1982). Phosphorus. *In*: Page, A. L.; R. H. Miller and D. R. Keeney (Eds). Methods of Soil Analysis. Part 2 Amer. Soc. Agron., Madison, W. I. USA, 403-430.

Page, A. L; R. H. Miller and D. R. Keeney. (1982). Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. Amer. Soc. Agronomy. Madison, Wisconsin, USA.

Palma-Guerrero, J.; H. B. Jansson; J. Salinas and L. V. Lopez-Llorca (2008). Effect of chitosan on hyphal growth and spore germination of plant pathogenic and biocontrol fungi. J. Applied Microbiol., 104:541-553.

Patkowska, E.; D. Pieta and A. Pastucha (2006). The effect of biochikol 020 pc on microorganisms communities in the rhisosphere of Fabaceae plants. Polish Chitin Soc. Monograph, 11:171-178.

Reddy, T. Y. and G. H. S. Reddi (1998). Principles of Agronomy, Kalyani Publishers Ludhiana, New Delhi, India.

Sharathchandra, R. G.; N. Raj; N. P. Shetty; K. N. Amruthesh and S. H. Shetty (2004). A chitosan formulation Elexa induces downy mildew disease resistance and growth promotion in pearl millet. Crop Prot. 23:881-888.

Smiley, R.; R. J. Cook and T. Paulitz (2002). Seed treatments for small grain cereals. Oregon State University Extension Publication EM 8797.

Stoner, R. and J. Linden (2006). Micronutrient elicitor for treating nematodes in field crops, Patent Pending, Pub. , US 2008/0072494 A1.

USDA NOP and EPA (2007). Rule on chitosan, Federal Register, Rules and Regulation, 72 (236): 69572- 69574.

Walker, R.; S. Morris; P. Brown and A. Gracie (2004). Evaluation of potential for chitosan to enhance plant defense. Publication No. 4 of Rural Industries Research and Development Corporation. Australia. (C.F. Computer Search).

Watanabe, S.; K. Kojima; Y. Ide and S. S. Sasaki (2000). Effects of saline and osmotic stress on Proline and sugar accumulation in *Populus euphratica* in vitro. Plant Cell Tissue and Organ Culture, 63(3):199-206.

Wise, R. (1995). Chilling-enhanced photooxidation: the production, action and study of reactive oxygen species produced during chilling in the light. Photosynthesis Research, 45(2):79-97.

Wojdyla, A. I. (2001). Chitosan in the control of rose disease-6 year trials. Bull. Polish Acad. Sci. Biol, Sci., 49:233-252.

Xu, H.; R. Wang; M. A. U. Mridha; H. L. Hu and R. Wang. (2000). Effect of organic fertilizers and a microbial inoculation on the leaf photosynthesis and fruit yield and quality of tomato plants. J. Crop Production, 3(1):173-182.

Yassen, A. A.; M. A. Khalil and S. M. Zaghloul (2004). Effect of humic substances and farmyard manure in combination with iron on sorghum plants. Egypt. J. Appl. Sci., 19(6B):784-798.

استجابة نباتات الحرنكش لبعض الأسمدة العضوية و الرش الورقي بالشيتوزان

أحمد مصطفى كمال* و خالد محمد غانم**

*** قسم بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة - مصر.**

****قسم البيئة و الزراعة الحيوية - كلية الزراعة – جامعة الأزهر- القاهرة- مصر.**

أجريت تجربتان حقليتان خلال موسمي ٢٠٠٩ و ٢٠١٠ بمزرعة خاصة بناحية النوبارية، محافظة البحيرة، مصر و ذلك لدراسة تأثير استخدام بعض الأسمدة العضوية مثل سماد الدواجن و سماد الأغنام و سماد الماشية و كذلك الرش الورقي بالشيتوزان بتركيزات ٠ ، ٤٠٠ ، ٨٠٠ جزء في المليون علي النمو و التركيب الكيماوي و المحصول و صفات الجودة لثمار نباتات الحرنكش صنف بلدي و ذلك في ظل نظام الزراعة العضوية.

وكانت أهم النتائج ما يلي:

- أدت إضافة سماد الغنم مع الرش الورقي بالشيتوزان بتركيز ٨٠٠ جزء في المليون إلي الحصول علي أعلي زيادة معنوية لصفات النمو الخضري متمثله في ارتفاع النبات وعدد الفروع والوزن الطازج و الجاف لنباتات الحرنكش بالإضافة إلي الحصول علي أعلي زيادة معنوية في محتوي النباتات من النيتروجين والفسفور والبوتاسيوم و كذلك محتوى الأوراق من الكلوروفيل الكلي.
- أدي التسميد العضوي بسماد الغنم مع الرش الورقي بالشيتوزان بتركيز ٨٠٠ جزء في المليون إلى الحصول علي أفضل تأثير معنوي علي صفات المحصول متمثله في زيادة نسبة عقد الثمار و عدد الثمار و متوسط وزن الثمرة و المحصول الكلي للفدان.
- أدي تسميد نباتات الحرنكش المنتجة عضوياً بسماد الغنم العضوي مع الرش الورقي بالشيتوزان بتركيز ٨٠٠ جزء في المليون إلي الحصول علي أعلى قيم فيما يخص محتوي الثمار من السكريات المختزلة و الكاروتينويدات و المواد الفينوليه العديدة و فيتامين ج، بينما أدي استخدام سماد الماشية العضوي مع عدم الرش الورقي بالشيتوزان إلي الحصول علي أقل النتائج.

و عليه توصي الدراسة بتسميد نباتات الحرنكش المنتجة عضويا بسماد الغنم كمصدر للسماد العضوي مع الرش الورقي بالشيتوزان بتركيز ٨٠٠ جزء في المليون و ذلك للحصول علي أعلى معدلات للنمو و المحصول و جودة الثمار و ذلك خلال نظام الإنتاج العضوي تحت ظروف منطقة النوبارية - محافظة البحيرة.

قام بتحكيم البحث

أ.د / حسام السعيد عبد النبي	**كلية الزراعة – جامعة المنصورة**
أ.د / السعيد لطفي فتحي	**مركز البحوث الزراعية**