EFFECT OF APPLIED ORGANIC MANURE AND FOLIAR SPRAY WITH ANTIOXIDANTS ON GROWTH, YIELD AND CHEMICAL CONSTITUENTS OF CARAWAY PLANT

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ABSTRACT

A filed experiments was carried out during two successive seasons of 2005/2006and 2006/2007 to study the effect of farmyard manure(FYM) at rates 0, 15, 25 and 35 m^3/fed. or foliar spray with applied of antioxidant (ascorbic acid)at rates 0, 5, 10 and 15mM./L, either alone or in combination with each other on growth, yield and some chemical constituents of caraway (*Carum carvi* L.,) plants. The obtained results indicated that, all growth parameters i.e., plant height, number of branches, number of compound umbels /plant; yield and its components i.e. fruits yield per plant or feddan, fruit oil %, fruit oil yield per plant and, or feddan , as well as some chemical constituents i.e. chlorophyll a, b , total caroteniods, nitrogen, phosphorous and potassium % in herb and total carbohydrates, total nitrogen and total protein% in fruits were significantly increased as a result of applied farmyard manure and ascorbic acid either added alone or in combination with each other. The best results were obtained by applying the middle rates of FYM and high (25 & 35 m^3/fed) and ascorbic acid 10 & 15 mM. /L) either added alone or in combined with each other, with insignificant differences. These treatments were statistically almost equal for producing significant values than the other treatments in the two studied seasons. From the economical point of view, the maximum increments in all studied growth parameters and chemical constituents as well as yield and its component were obtained by fertilization with farmyard manure at rate 25 m^3/fed. combined with foliar spray by ascorbic acid at rate 10mM./L under the prevailing conditions of the current expermint.

Key words: Caraway (*Carum carvi* L.), farmyard manure "FYM', antioxidants, ascorbic acid, "growth parameters and chemical constituents.

INTRODUCTION

Caraway (*Carum carvi* L.,) is a popular, medicinal spices plant of Lamiaceae and is well known for it's highly aromatic and ingredient of cough-relieving, stomachache, diuretic, carminative tea blends used in food industries for spicing canned drinks. It is most important species being utilized as a source of essential oil.

The organic matter content of Egyptian soil is usually less than 2% in cultivate area. Frequent the application of organic manure are necessary to maintain soil fertility and to provide the growing plants with their nutritional requirements without having an undesirable impact on the environmental condition. Organic fertilization also provides a means for alleviating the problem of chemical residues in the exporting market. Stimulation growth characters by fertilized with organic manure was observed by **Aly (1999)** on *Nigella sativa* L.(black cumin) plants; **Mohamed and Matter (2001)** and **Somida, (2002)** on *Tagetes minuta* L.; **Abd El-Raouf (2001), El-Gendy *et al.*,**

2001), **El-Yazal, *et al.*, (2005**) and **Matter and Somida (2006)**on *Ocimum basilicum* L., and **Mohamed (2006) on** *Hibiscus esculenta* L plants.

Recently, this is a widespread use of natural and safety substances such as antioxidants, particularly ascorbic acid, for enhancing the health, growth and productivity of many crops. Since, antioxidants have synergistic effect on growth, flowering, yield and chemical composition under favorable and unfavorable environmental condition, due to these compounds as non enzymatic material and have a beneficial effect on catching the free radical or the active oxygen species namely singlet oxygen, super oxide caraway, hydrogen peroxide, hydroxyl radicals and ozone that oxygen that producing during photosynthesis and respiration process (**Zhang and Klessing, 1997**). Leaving these free radicals without chelating or catching leads to lipids oxidation and the loss of plasma membrane permeability and the death of cell within plant tissues. They also have an auxin action (**Prusky, 1988 and Raskin, 1992).** The beneficial effect of antioxidants on growth ,yield and some chemical constituents of several plants was reported by several workers such as **Reda *et al.* (1977**)on *Ammi visnaga* L**. ; El-Kholy and Salem (1980)**on *Matricaria chamomilla* L**.; Arulniozhiyan and Pappaiah (1989)** on marigold (C*alendula officinalis* L.)**; Abd-El-Hamid *et al.* (1994)**on Opuntia (ficus-indica)**; Dobariya and Mehta (1995)** on Indian mustard (*Brassica juncea* L.)**; Rai (1997)** on *Bauhinia purpurea* L.**; Tarraf *et al*. (1999)** on lemongrass (*Cymbopogon citrates* L.); **El-Khayat (2001)** on roselle **(***Hibiscus sabdariffa* L.); **El-Fawakhry and El- Tayeb (2003)** on *Dendranthema grandiflorum*; **Taha (2005)** on tuberose (*Polianthes tuberose* L.) plants; **Rady (2006**) on sunflower *(Helianthus annuua* L.)**;** and **El-Yazal (2007)** on onion (*Allium cepa* L.) plants.

This study was conducted with the aim of studying the effect of organic manure (farmyard manure) either alone or in combination with antioxidants (ascorbic acid) on the growth, oil yield and some chemical components of caraway (*Carum carvi* L.,) plants.

MATERIAL AND METHODS

The present investigation was carried out during the two successive seasons of 2005/2006 and 2006/2007 at Sennouris, Fayoum Governorate. Before planting the most important physical and chemical properties of the selected soil were determined (Table 1) according to **Wilde *et al.* (1985).** Farmyard manure was obtained from private farm in Sennouris, El-Fayoum Governorate. Also, some chemical properties of the used farmyard manure are shown in Table (1).

Seeds of caraway (*Carum carvi* L.,) were obtained from the Research Center of Medicinal and Aromatic plants in Giza, Egypt in the two successive seasons of the study. On October 15th of each season, seeds were sown in hills 30 cm apart (4 seeds/hill) each plot (2.4×2m) contained 4 rows (60 cm wide with 3 m length). Each plot contained 26 hills and plants were thinned to two plants per hill after 5 weeks from planting. The experimental design used was factorial experiment in randomized complete block with four replications. Farmyard manure (FYM) at the rates 0, 15, 25 and 35 m^3/fed., were applied at one dose and incorporated with the soil at two weeks before sown. The plants were sprayed with tap water (as a control) or ascorbic acid at rates of (5, 10 and 15 mM). Few drops of Triton B as a wetting agent at 0.1 % were added to the spraying solution as a surfactant. The foliar applications were carried out at 30 and 60 days after sowing.

Table (1): The physical and chemical of used soil and organic fertilizers before planting in both seasons.

Properties		Soil		Farmyard manure	
		1st	2nd	1st	2nd
Sand %		44.90	44.95	-	-
Silt %		30.28	30.21	-	-
Clay %		24.82	24.84	-	-
Texture grade		Loam	Loam	-	-
Organic matter%		1.70	1.76	33.28	35.29
pH		7.56	7.50	6.60	6.68
EC, dS/m		4.51	4.57	7.20	7.28
Total N %		0.083	0.089	1.38	1.43
Available nutrients (mg/kg)	P	7.03	7.12	38.8	38.5
	K	460	465	733	735
	Zn	1.71	1.78	162	166
	Mn	2.90	2.99	125	120
	Cu	1.22	1.28	22.80	22.84
	Fe	6.60	6.67	953	950

1:2.5 (soil) 1:10 (FYM) solid material : water suspension

Data recorded:-

Growth parameters:

Different growth parameters i.e. plant height (cm), number of branches, number of compound umbels/plants, were determined at the age of 120 days (flowering 25%).

Yield and its components:

At harvest stage (at the age of 180 days) fruits yield per plant (g), per feddan (kg) and fruit oil % were determined

Chemical constituents:

The following chemical constituents were determined in leaves at the age of 120 days and in fruits at harvest (180 days).

Photosynthetic pigments: chlorophyll a, b and total caroteniods were extracted from fresh leaves by acetone (80%) then, their concentrations were determined as mg/100g fresh weight according to **Welburn and Lichtenthaler (1984),** Total carbohydrates(mg/g dry weight) were determined calorimetrically by using phenol-sulphuric acid reagent according to the method described by **Herbert *et al.* (1971)**.

Nitrogen %, in leaves and fruits was determined according to micro Kjeldahl as described by **A.O.A.C. (1995)**, and protein percentage in fruits was calculated by (nitrogen % x 6.25), phosphorus % was determined according to **A.O.A.C. (1995)**, potassium was determined by Flame Photometer, Parkin–Elmer model 52 according to the method described by **Page *et al*. (1982).**

Essential oil in the fruits (crushed) was extracted by water distillation, and then dried over anhydrous sodium sulphate and determined according to **Gad *et al*.** (**1963)** and recorded as oil %, then oil yield per plant and per feddan were calculated.

Statistical analysis:

The experiment was in a complete randomized block design with 16 treatment and 4 replicates for each treatment. Results were statistically analyzed using the L.S.D. at probability level of 5% for comparisons (**Gomes and Gomes 1983).**

RESULTS

A - Growth characteristics:

1 – Plant height and number of branches:

Data in Table (2) clearly show that the application of different rates of farmyard manure significantly increased plant height and number of branches, especially at the medium (25 m^3/fed) and highest rates (35 m^3/fed.). These increases reached 6.94 and 7.88% in the first season and 8.32 and 9.11 % in the second one, respectively for plant height . The corresponding values for number of branches were 41.04 and 43.92% in the first one, and 41.98 and 45.49% over the unfertilized plants in the second one respectively. In the meantime, both medium (25 m^3/fed). and highest rates (35 m^3/fed). statistically, were achieved in significant differences for plant height and number of branches than the low rate 15m^3/fed. and the control in the two experimental seasons. From the economical side, the highest values were obtained when Caraway plants received farmyard manure at rate 25 m^3/fed.,

Concerning the effect of ascorbic acid on plant height and number of branches, the data in Table (2) indicated that all rates of ascorbic acid significantly increased plant height and number of branches as compared with the control plants in both seasons. The best results were obtained by medium and highest rates (i.e., 10 and 15 mM/L. respectively.) which recorded 8.12 and 8.84 % in the first season and 8.73 and 9.58 % in the second ones for plant height; and 47.31 and 50.14 % in the first season and 42.72 and 45.29% in the second ones for number of branches respectively, over the control plants. On the other hand both treatments statistically, were achieved in significant differences increase in plant height and number of branches.

A combination between farmyard manure and ascorbic acid gave the better results than the solely treatments or untreated plants. The most effective treatments which gave the tallest plants and higher numbers of branches were due to the use of high rate of organic manure combined with high rate of ascorbic acid treatments in both studied seasons.

2-Number of compound umbels/plants and fruits yield per plant (g) and per feddan (kg).

The obtained data in Table (2) show clearly that number of compound umbels/plants, fruits yield per plant and per feddan of caraway plants were gradually and significantly increased with increasing the rate of farmyard manure up to 35 m^3/fed.in both seasons as compared to the control plants. Both the medium (25 m^3/fed) and highest rates (35 m^3/fed).were statistically achieved in significant increases than the other treatments. The increases were recorded 46.22 and 48.57% in the first one and 46.41 and 51.79% in the second one for number of compound umbels/plants; 24.06 and 25.00% in the first season and 23.70 and 24.65% in the second season for fruits yield per plant and feddan, respectively, over the control plants. From the economical side, the highest values were obtained when Caraway plants received farmyard manure (FYM) at the rate 25 m^3/fed.,

Regarding the effect of ascorbic acid application, it was clearly show that number of compound umbels /plants, fruits yield per plant and, feddan of caraway plants were also gradually increased by increasing the rate of ascorbic acid. The highest increase of number of compound umbels /plants, fruits yield per plant and feddan of caraway plants were obtained by using ascorbic acid at the rates of 10 and 15 mM./L. which recorded 46.75 and 49.77% in the first season and 40.69 and 43.21% in the second one for number of compound umbels/plants; 28.56 and 28.99% in the first season and 27.04 and 27.15% in the second one for fruits yield per plant and feddan, respectively, over the control plants.

The interaction between the organic manure fertilization and ascorbic acid treatments was significant for the number of compound umbels /plants, fruits yield per plant and, feddan of caraway plants in the two seasons as compared with the control. The maximum increase was obtained by the treatment 35 m^3 FYM/fed plus 15mM ascorbic acid./L which recorded 152.93 and 147.97% for number of compound umbels /plants and 95.24 and 96.37 % for fruits yield per plant and feddan respectively over the control plants in the first and the second seasons, respectively. But the four combinations (M2+A2 or M2+A3 or M3+A2 or M3+A3) were, statistically achieved insignificant differences for number of compound umbels/plants, fruits yield per plant and feddan in the two studied seasons, as show in Table (2).

3- Oil yield:

Data in Table (3) show clearly that oil percentage per plant and oil yields per plant and feddan of caraway plants were gradually and significantly increased with increasing farmyard rates up to 35m^3/fed.,in both studied seasons as compared to the control plants. Both the medium rate (25 m^3/fed) and highest rates (35 m^3/fed) were statistically, achieved in significant increases than the other treatments .The increases reached about 8.13 and 9.01 % in the first season and 7.70 and 8.57% in the second one for oil percentage per plant, 34.00 and 36.05 % in the first season and 32.99 and 35.05% in the second one for oil yield /plant and oil yields per feddan respectively, as compared to the control plants.

Regarding the effect of ascorbic acid, it was clearly show that oil percentage per plant and oil yields per feddan of caraway plants were gradually increased by increasing the rates of ascorbic acid. The highest increase of oil percentage per plant and oil yields per feddan were obtained by used of both rates 10 and 15 mM/L, with insignificant differences in the two seasons, however recorded 5.67 and 6.05% in the first season and 5.06 and 5.42% in the second one for oil percentage per plants and 35.53 and 36.48 % in the first season and 33.02 and 33.60% in the second one for oil yield per plant and per feddan, respectively, over the control plants.

The interaction between the organic manure fertilization and ascorbic acid treatments was significant for increasing oil percentage per plant and oil yields per plant and per feddan as compared with the control in the two studied seasons. The maximum increase in the experimental was obtained by the use of 35m^3 FYM/fed from organic manure plus 15mM ascorbic acid./L, which recorded 15.34 and 15.04% for oil percentage per plant and 125.24 and 125.98 % for oil yields per feddan over the control plants in ether and second seasons respectively.

B- Chemical constituents:-

1- Pigments:

Data recorded in Table (3) clearly show in the two growing seasons that, farmyard fertilization had a simulative effect on chemical constituents of caraway plants. Photosynthetic pigments represented by chlorophyll a, b and caroteniods were gradually increased with increasing the rate of farmyard used. The best results were obtained with the medium (25 m^3/fed) and highest rates (35 m^3/fed). of farmyard manure, with insignificant between them. At the first season the corresponding increments over the control recorded 9.32 and 10.69 % for chlorophyll. a; 13.42 and 14.42% for chlorophyll b and 20.29 and 23.41% for caroteniods, as respectively compared to the untreated plants. A similar trend was observed in the second season.

The obtained data in Table (3) clearly show in two growing seasons that, foliar application of antioxidant rates had a simulative effect on chemical constituents of caraway plants. Photosynthetic pigments represented in chlorophyll a, b and caroteniods were gradually increased with increasing the rate of ascorbic acid used. The best results were obtained with the medium and high rate (10 and 15mM./L.) of ascorbic acid, with insignificant between them. The increments over the control were recorded 12.20 and 13.24 % for chlorophyll a; 15.68 and 17.11 % for chlorophyll b and 26.95 and 28.97% for caroteniods in the first season, respectively, as compared to the untreated plant. A similar trend was observed in the second season, Table (3).

The interaction between the organic fertilization and ascorbic acid treatments was significant in photosynthetic pigments of caraway plants in the two seasons as compared with the control plants. The maximum increase in the studied experiment was obtained by the treatment of 35 m^3FYM/fed plus 15mM ascorbic acid/L, which recorded 26.82 % for chlorophyll a , 37.45 for chlorophyll b and 66.41 % for caroteniods over the control plants in first season. A similar trend was observed in the second season.

2- Nitrogen, phosphorus and potassium concentrations in the herb:-

Data presented in Table (4) indicated that, caraway plants contained a high concentrations of nitrogen, phosphorus and potassium under farmyard fertilizations as compared to the control plants. Moreover, the mineral elements (NPK) were significantly increased with increasing farmyard fertilizer rates. The maximum increase was obtained from farmyard fertilization at both medium (25 m^3/fed) and highest rates (35 m^3/fed) with insignificant differences between them. The corresponding increase recorded 4.47 and 4.88 % for nitrogen; 4.63 and 5.25% for phosphorus and 5.76 and 6.36% for potassium at the first season over the control plants respectively. A similar trend was observed in the second season Tables (4).

Regarding the effect of ascorbic acid, it was clearly show that nitrogen, phosphorus and potassium of caraway plants were also gradually increased by increasing the rates of ascorbic acid. The highest increase was obtained by using 10 and 15mM./L, which recorded 7.86 and 8.49% in for nitrogen ;8.54 and .49% for phosphorus and 9.49 and 10.64% for potassium over control plants in the first season respectively,. A similar trend was observed in the second season Table (4).

The interaction between the organic manure fertilization and ascorbic acid treatments was significant for nitrogen, phosphorus and potassium of caraway plants in the two seasons as compared with the control. The maximum increase in the experiment was obtained by the treatment of 35 m^3/fed from

organic manure plus 15mM./L. ascorbic acid, which recorded 14.31% for nitrogen, 15.79 for phosphorus and18.27 for potassium over the control plants respectively in first season. A similar trend was observed in the second season

2- Total carbohydrates, total nitrogen and total protein percentages in fruits:

Data recorded in Table (4) show that organic fertilization had a simulative effect on total carbohydrates, total nitrogen and total protein percentages in fruits. The best results were obtained with the medium (25 m^3/fed) and highest rates (35 m^3/fed) with insignificant differences between them. At the first season these increases recorded 1.71and 1.91% for total carbohydrates, 0.32 and 0.41% for total nitrogen and total protein in fruits over untreated plants respectively. A similar trend was observed in the second season Table (4).

The obtained data in Table (4) show that ascorbic acid application had a simulative effect on total carbohydrates, total nitrogen and total protein in fruits. The best results were obtained with the rates 10 and 15mM./L. with insignificant between them. At the first season, these increases recorded 1.10and 1.22 % for total carbohydrates, 0.55 and 0.59 % for total nitrogen and total protein percentages in fruits over untreated plants respectively. A similar trend was observed in the second season Table (4).

The interaction between the organic manure fertilization and ascorbic acid treatments was significant in total carbohydrates, total nitrogen and total protein percentages in fruits of caraway plants in the two seasons as compared with the control. The maximum increase in the experiment was obtained by the treatment of 35 m^3/fed from organic manure plus 15mM/L ascorbic acid, which recorded 3.02% for total carbohydrates, 0.98 for total nitrogen and total protein percentages in fruits over the control plants in first season. But the four combinations (M2+A2 or M2+A3 or M3+A2 or M3+A3) were, statistically achieved insignificant differences for total carbohydrates, total nitrogen and total protein percentages in fruits in the first season as clearly indicated in Table (4). A similar trend was observed in the second season.

DISCUSSION

Fertilizing the plants with organic manure resulted in vigorous growth of those as well as highly productivity of fruits with good quality. An increase in each of the measured growth characters (plant height etc….), yields and their component as well as oil production of caraway plants was due to that the application, which fertilizers resulting in more release of available nutrients (micro or macro ones) to be absorbed by the tested plants. It is necessary to refer the physiological roles of these nutrients such as macronutrients (nitrogen, phosphorous and potassium) and micronutrients (Fe, Mn, Zn and Cu) in plant growth and development. The important role of nitrogen in amino acids, protein, chlorophyll, enzymes and energy transfer substances (ADP and ATP) were early recorded by **Russel (1973).** Also, the role of phosphorus compounds are of absolute necessity for all living organisms, nucleoproteins constituting the essential substance of the cell and for cell division and development of meristematic tissues (**Yagodin, 1982).** Moreover, potassium is needed in relatively large amounts by all plants. It aids in the uptake of other nutrients and their movement within the plant. The increasing in growth parameters by organic manure application may be turned to the effect of organic substances on increasing the availability elements and their supply to plants and its effect on the physiological processes such as photosynthesis activity as well as the utilization of carbohydrates. (**Beringer, 1978). Mengel and Kirkby (1987)** reported that the role of K in metabolism, growth and yield formation can be characterized by two major function : as an activator of enzymes and as K^- ions are very mobile within the plant as well as within a cell are transported through biological membranes with high rate and specificity. More than 60 enzymes are known to require K^+ as an activator. The high mobility of K^+ on photosynthesis phloem loading and phloem transport…etc. Such three nutrients are among the major essential nutrients needed in large quantities for all plants. They participate directly or indirectly in much important physiological process carried simultaneously within plant cells, tissues and organs differentiation. Micronutrients in sort of fertilizers are necessary because the soil is usually in deficient of them or they are not readily available for plants. The role of Fe, Mn, Zn, and Cu are involved in every metabolic processes such as carbohydrate, protein, growth substances biosynthesis, stomatal movement and translocation of assimilates within the plant were reflected positively on vigorous vegetative growth **[Kneel (2002)** *on Ocimum basilicum* L., **Matter and El-Yazal (2002)** on Damsisa, **Youssef *et al.* (2004)** on *Ocimum basilicum* L., **Matter** and **Mohamed (2001), Agamy *et al.* (2004)** on *Calendula officinalis* L., and **Rady *et al.* (2005)** on Amaryllus plants]. An increase for each of the measured growth characters (plant height etc..) was due to the application of these fertilizers, which resulting in more availability of micronutrients (Fe, Mn and Zn) to be absorbed by the recorded plants. The positive action for antioxidants especially, ascorbic acid on growth might be attributed to their effects on counteracting drought, salinity and diseases stresses and protecting plant cells against free radicals that responsible for plant senescence as well as to their auxinic action, and consequently enhancing growth characters **(Raskin, 1992 and Elade, 1992).** In addition, ascorbic acid might be regulates cell wall expansion, cell division and cell elongation through its action in cell vacuolarization (**Arrigoni, 1994; Gonzalez-Reyes *et al.* 1994 and Navas and Gomez-Diaz, 1995**), improves the nutritional status and absorbing phenolic compounds, which lead to save

the growing tissues from toxic effects of the oxidized phenols **(Gupta *et al*., 1980)** and/or enhances the biosynthesis of carbohydrates **(Ahmed, 2001)** and translocation of sugars (**Farag, 1996**) which could be explain the present results. These findings are in coincidence with those obtained by **Ahmed *et al*. (1998) and (2003), Tarraf *et al*. (1999) and Mostafa (2004)**. In this respect, **Al-Qubaie (2002)** stated that ascorbic acid as an antioxidant compound has an auxinic action and also synergistic effect on the biosynthesis of carbohydrates and controlling the incidence of most fungi on plants makes them in vigour states and reflects on seed and oil yields. Besides, the induced effect of ascorbic acid as one of vitamins on oil content may be due to that vitamins are recognized to be coenzymes involved in specific biochemical reactions in plants such as oxidative and nonoxidative decarboxylations (**Robinson, 1973**). Furthermore, **Tarraf *et al.* (1999)** reported that an increase in essential oil content of lemongrass was occurred as a result of the foliar spray with ascorbic acid. The results regarding the beneficial effect of ascorbic acid on yield are confirmed with those reported by **Ahmed *et al*. (1998), (2003) and (2004), Hammam *et al*. (2001) and Mostafa (2004)**.

Moreover, microelements (Zn, Fe and Mn) combined with organic manure also have an improvement effect on vegetative growth parameters. This may be attributed to the essential role of Zn in synthesis of triptophan amino acid, and consequently formation of auxin, i.e. IAA, which acts as growth regulator especially in prolonging height of plants **(Devendra *et al.* 1999).** Also, the favorable effect of the applied treatments on number of branches may be due to its stimulating effect on vegetative growth and physiological processes, i.e. increasing number of cells through cell division and cell elongation and meristematic activity of tissues. The stimulating effect of ascorbic acid on plant growth may be due to its role in transmission of the electron from water to chlorophyll and producing oxygen gas in the photosynthesis, in addition to its role in the nitrogen metabolism through activated nitrite reductase enzyme **(Baza, 1984).** The beneficial effect of ascorbic acid and organic manure on yield and its components was mainly attributed to its positive action on enhancing growth parameters (Table, 2) and photosynthetic pigments of plants leaves (Table 4). In this respect, **Al-Qubaie (2002)** stated that antioxidant, especially ascorbic acid, has an auxinic action and also synergistic effect on the biosyntheses of carbohydrate and controlling the incidence of most fungi on plants makes them in vigorous states and consequently reflected on fruit yield. Also, **Larson, (1988)** reported that, non-enzymic antioxidants play a role in resistance to physiologic disorders caused by oxidative stress. Antioxidant compounds are found in all higher plants, and they include ascorbic acid, *a*-tocopherol, *b*-carotene, glutathione, and other flavonoids. Moreover, the increase in yield and its components by organic manure treatments may be attributed to the metabolic role of Zn, Fe and Mn in organic manure on plant. In this respect**, Wilson and Allison (1978**) suggested that grain yield may sometimes be limited by photosynthesis (source) and grain (sink) simultaneously and it is possible to increase grain yield by keeping safe the balance between them. The favorable effect of the constituents of organic manure from Zn, Fe and Mn on fruit yield and its components might be attributed to the increase in photosynthetic pigments concentration **(Price *et al*., 1972)** as well as enzyme activity, which consequently enhancing plant metabolism **(Boardman, 1975)**. Also, zinc has essential role in carbohydrate metabolism, protein synthesis, triptophan and

IAA synthesis, since it activates number of enzymes for photosynthesis **(Marschner, 1995).** The promotive effect of organic manure and ascorbic acid on leaf pigments concentration might be attributed to the enhancing effect of antioxidants and organic manure on the nutritional status of caraway plants, which responsible for accelerating the biosynthesis of various pigments leading to the increase in biosynthesis of sugars. In this respect, the stimulating effect of organic manure on chlorophyll formation and total carbohydrate concentrations were reported by **Mohr and Schopfer (1995)** who stated that this increase may be due to the enhancing effect of Fe, Mn and Zn on chlorophyll formation and consequently photosynthesis. In this respect, **Price *et al*. (1972)** reported that the basic function of zinc in plant was related to its role in carbohydrates metabolism. The increase in macroelements (N,P, and K) were supported by the results of **Ahmed and Abd El-Hameed (2004)** who reported that the effect of antioxidants on producing healthy plants leads to enhance the plants to have a great ability for uptake mineral elements. Moreover, **Devlin and Withman (1985)** reported that, the increase in leaves N, P and K may be due to the effect of Zn on biosynthesis of auxin (IAA) which promote rooting process and root distribution, and consequently the amounts of mineral elements absorbed by roots and translocated into the different parts of the plant. Also, the use of organic manure led to an increase in root growth and there by higher uptake of macro and micronutrients. The increase in protein content of fruits may be attributed to the increment in total nitrogen percent of leaves and fruits.

Finally, from the present results, it could be concluded that the application of organic manure and/or ascorbic acid greatly increased caraway growth and yield as well as improved fruit quality and its chemical constituents. The content of these substances from elements participate in the different metabolic processes which increased syntheses of chlorophyll, carbohydrates, and absorption of essential nutrients, so that the used organic manure with ascorbic acid could be increase caraway productivity with high quality fruits.

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تأثير إضافة المخصب العضوي والرش بمضادات الأكسدة على النمو والمحصول والمكونات الكيمائية لنبات الكراوية

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أجريت تجربة حقلية خلال موسمين متتابعين هما ٢٠٠٥/٢٠٠٦و ٢٠٠٦/٢٠٠٧م لدراسة تأثير إضافة السماد العضوي (سماد بلدي بمعدلات صفر، ١٥، ٢٥، ٣٥م٣/فدان) و الرش بمضادات الأكسدة (حامض الأسكوربيك) بتركيز صفر، ٥، ١٠، ١٥ ملي مول /لتر كإضافة منفردة أو مشتركة وعلى النمو والمحصول والمكونات الكيماوية لنباتات الكراوية.

وتشير النتائج إلى:

* حدوث تحسن في صفات النمو (طول النبات، عدد الفروع للنبات، عدد النورات) ومحصول الثمار للنبات والفدان، نسبة الزيت فى الثمار، محصول الزيت للنبات والفدان، محتوى الأوراق من الكلوروفيل أ، ب والكاروتين ومن النتروجين والفسفور والبوتاسيوم ومحتوى الثمار من الكربوهيدرات والنتروجين والبروتين حيث قد زادت قيم هذه الصفات بدرجة بمعنوية باستخدام التسميد العضوي والرش بمضادات الأكسدة بصورة منفردة أو مشتركة.

* أعطى كل من المعدل المتوسط والمعدل العالي (٢٥، ٣٥ م٣/ف) من السماد البلدي و(١٠، ١٥ ملي مول/لتر) الرش بحامض الأسكوربك أعلى نتيجة تم الحصول عليها حيث ان الفروق بينهما غير معنوية من الوجهة الإحصائية.
* بالإضافة إلى أن سماد البلدي بمعدلي ٢٥، ٣٥ م٣/ف متحدا بالتبادل مع الرش بحامض الأسكوربك بمعدل١٠، ١٥ ملي مول /لتر أعطوا أحسن نتيجة مقارنة بالتفاعلات الأخرى وذلك لعدم وجود فرق معنوي من الوجه الإحصائية.
* ومن الوجهة الاقتصادية، فأن أفضل النتائج التي تم الحصول عليها بالنسبة لصفات نمو نباتات الكراوية والمحصول ومكوناته الكيمائية قد تحققت باستخدام التسميد العضوي بمعدل٢٥ م^{٣}/ ف سماد بلدي الرش بمضادات الأكسدة (حامض الأسكوربك) بمعدل ١٠ ملي مول /لتر تحت ظروف التجربة التي تم إجرائها.