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Effect of compost rates and foliar application of ascorbic acid on yield and nutritional status of sunflower plants irrigated with saline water

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ABSTRACT

A field experiment was carried out during the two summer seasons of 2012 and 2013 at El- Areish Research Station, North Sinai Governorate, Egypt, (lat. 31.05 and long. 33.50) to study the effect of different rates of compost i.e. 0, 2 and 4 ton fed^{-1} combined with foliar application of ascorbic acid at different rates (0, 0.2, 0.4 and 0.6 g L^{-1}) on growth, yield, its components and nutritional status of sunflower plants variety Sakha 1. Results could be summarized as follows: increasing the addition of compost up to 4 t fed^{-1} or ascorbic acid concentration up to 0.6 g L^{-1} increased significantly values of plant height, plant dry matter, chlorophyll A, B and A+B content at 90 days from planting as well as the head diameter, seed yield/ plant, 1000 seed weight and seed yield (t fed^{-1}) of sunflower plant at harvest time 120 days from planting. Also, N, P, K and oil percentage of sunflower seeds with compared to control treatment (without addition of compost) in both seasons. Generally, the results in most cases, demonstrate that the all parameters increased significantly by using the high concentration of ascorbic acid 0.6 g L^{-1} combined with higher rates from compost 4 t fed^{-1} in both seasons.

Keywords: Effect, compost, foliar application, nutritional status, sunflower, plants, saline water.

INTRODUCTION

Sunflower (*Helianthus annuus L.*) is considered one of the most important oil crops in the world. Therefore, an enhancement of the productivity of this crop is required to meet the scarcity of crop oils. In Egypt, sunflower is modified to different soil types and climate conditions. This wide malleability led to the fact that sunflower can be grown in less productive soils, particularly, in the newly reclaimed areas of Egypt. The poor quality of desert soil requires extensive efforts to improve its hydro-physical properties as well as its productivity; accordingly, applications of organic matter to such soil are needed. Egypt's oil consumption has enlarged over recent years. In 2005, the production average of sunflower was 39,000 tons, while the consumption amounted to 376,000 tons in the same year (FAO, 2006). The production of crop oils is still, consequently, below current needs, since it covers about 10% of the consumption (El-Fayoumy *et al.*, 1999). Egypt suffers from water deficiency problems and the use of non-traditional sources such as irrigation by saline water become necessity in recent years. Overcoming harmful effects of salinity stress and improving salt tolerance is considered one of the challenges for raising plant growth and productivity.

Compost may be utilized in the soil as a source of macro and micronutrients for crop production (Parr and Hornick, 1990). Increasing compost addition in the newly reclaimed soils significantly increased both the dry matter production and yield of fruits (Abou El-Seoud *et al* (1997). Sowicki (2003) stated that compost addition significantly increased sunflower dry weight, seed yield, oil content and major elements (NPK). Organic fertilization is a very important to supply the plants with their nutritional necessities without having as undesirable impact on the environment. Addition of compost could be a way to improve soil structure and aeration, creating a better environment for plants growth. The organic matter content of soils can be enhanced by growing and plowing under green manure crops, or by plowing under organic residues such as manure, crop residues and composts of different origin. When compost is applied to the soil, it can support plant growth and enhance plant yield as well as improve the physical, chemical and biological properties of soils (Convertini *et al.*, 2004). Moreover, Maiorana, *et al.*, (2005) concluded that the compost application allowed good yields and quality, even without an additional mineral fertilization. Additionally, its application could improve the soil organic matter and minimize the problems related to waste disposal and to reduce the environmental pollution caused by a huge application of mineral fertilizers. Louisa, and Taguiling, (2013) stated that soil fertility deterioration is a major constraint for higher crop production. The increasing land use intensity without adequate and balanced use of mineral fertilizers and with little or no use of organic fertilizer or compost have caused severe soil fertility worsening resulting in poor harvest of crops grown. Since fertile soil is the primary resource for higher crop production, its maintenance is a prerequisite for long-term sustainable agricultural. They added that soil organic matter is a key factor for sustainable soil fertility and crop productivity. Organic matter undergoes mineralization with the release of substantial quantities of N, P, K, S and smaller amount of micronutrients. Moreover, most of the cultivated soils in our country have organic matter far way below a good agricultural soil that should contain at least 2% organic matter. Also, they stated that the compost does more than providing organic nutrients: it improves the water and nutrient holding capacity of coarse-textured sandy soil.

Ascorbic acids is present in all living plant cells, the biggest amounts being usually in the leaves and flowers, i.e., in actively growing parts (Ebrahim, 2005). Ascorbic acid serves as a hydrogen transport agent which is concerned in cellular oxidation reduction reactions. Attempts have been made to occupy active vitamins to overcome the drastic effects of salinity on seed germination and seedling growth as well as on some metabolic mechanisms (Samiullah and Afridi, 1988). Addition of ascorbic acid to salt treated plants reduced the inhibitory effect of NaCl on pigment content while it slightly enlarged the total pigment contents at the vegetative stage. Amin *et al.* (2008) reported that there was a gradual increase in chl. a, and chl. b with increasing concentration of ascorbic acid up to 400 mg/l over their corresponding control at two stages of wheat plant growth. Similarly, Abdel-Wahed *et al.* (2006) on maize, and El-Gabas (2006) on sunflower plants found that ascorbic acid improved chlorophyll a, b, total chlorophylls, and attributed this to stimulation of biosynthesis of chlorophylls and delay in leaf senescence. Khafagy *et al.* (2009) concluded that application of ascorbic acid significantly improved both chlorophyll a and b concentrations as compared with control. Abou-Leila, *et al.*, (2012) found that ascorbic acid treatments under saline condition cannot alleviated the inhibitory effect of salinity by accumulation of protein, while it has increasing effect on some selected ions such as Mg ++ and decreasing effect on Na+ at the higher salinity levels. Furthermore, Mohsen, *et al.* (2014) investigating the changes in growth and some metabolic activities in NaCl-stressed bean plants, and assessing the role of ascorbic acid to alleviate these changes. He established that the ascorbic acid addition to stressed plants reduced the inhibitory effect of NaCl on pigment content.

The purpose of the present investigation is to study the effects of compost rates and foliar application of ascorbic acid at different concentration on growth, yield components, seed yield, and oil % as well as the percentage of some macronutrients by plants grown in a sandy loam soil irrigated with saline water.

MATERIALS AND METHODS

A field experiment was carried out during 2012, 2013 seasons at El- Areish Research Station, North Sinai Governorate, Egypt, (lat. 31.05 and long. 33.50).The experiment was arranged in a split plot in randomized complete block design, with four replicates. Each plot covered an area of 14.00 m^2 (3.5 x 4.00 m) and consisted of five ridges, five meter in length and 70 cm apart. There was a gap of 30 cm between two plants. This experiment was carried under drip irrigation system.

Surface soil samples (0-30 cm depth) were taken initially before performance of the experiment to determine their chemical analysis (Soil, water and compost) and particle size distribution according to the standard methods by **Ryan *et al.* (1996),** those are summarized in Tables (1, 2a and 2b).

Table 1. Some physical and chemical properties of the experimental site

Properties	Particle size distribution (%)					EC_e	pH	$CaCO_3$	Soluble ions (meqL^{-1})							Available nutrients			OM	OC	TN	C / N
Season	C. S	F. S	Silt	Clay	T C	(dSm^{-1})	(1:2.5)	(%)	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}	N	P	K	%			
2012	11.80	55.20	32.15	0.85	SL	3.18	7.92	21.40	4.60	11.70	13.40	1.70	8.60	15.50	7.30	11.82	4.20	28.40	2.07	1.20	0.11	10.91
2013	12.70	51.90	34.75	0.65	SL	3.39	8.10	22.15	5.20	12.40	14.10	1.30	10.30	14.60	8.10	12.55	3.70	26.30	2.40	1.40	0.13	10.77

CS= Coarse sand- FS= Fine sand TC=Textural class SL= Sandy loam OM=Organic matter OC=Organic carbon TN= Total nitrogen C / N ratio

Table 2a. Some chemical analysis of the used irrigation water

Seasons	Parameters EC_e (dSm^{-1})	ppm	pH	Soluble cations (mqL-1) Na^+	Mg^{++}	Ca^{++}	K^+	Soluble anions (mqL-1) Cl^-	$HCO3^-$	$CO3^-$	$SO4^=$
2012	5.22	3340	7.1	38.6	4.8	8.4	0.1	40.3	4.5	-	7.1
2013	5.53	3538	7.3	39.8	5.7	9.2	0.1	42.8	5.3	-	6.7

Table 2b Some chemical analysis of the used compost.

Season	Parameters *ECe (dSm-1)	**pH	O C %	OM %	C/N ratio	N %	P	K	Fe ppm	Mn	Zn
2009/2010	1.35	6.6	28.25	48.59	17.74	1.54	1.09	1.69	395	101	78
2010/2011	1.23	6.2	25.98	44.69	16.37	1.48	1.11	1.72	384	106	92

* Compost pest

** Compost suspension 1: 2.5

The field experiment was conducted to study the effect of compost rates and different concentrations of ascorbic acid on growth, yield, its components and nutritional status of sunflower plants. Seeds of sunflower (*Helianthus annuus L.*) variety Sakha 1 were sown on 20th and 26th June in 2012, 2013 seasons, respectively.

Plant material and experimental work:

The main plots were received a compost rates i.e., zero, 2 and 4 t fed^{-1} and sub plots were received a foliar application of ascorbic acid i.e. without (control), 0.2, 0.4 and 0.6 g L^{-1}. Drip irrigation system was practiced in this study.

Basic dressing was applied to all plants which consisted of nitrogen (ammonium nitrate 33.5% N at 180 kg/fed), phosphorus (superphosphate (15.0% P_2O_2 at 200 kg/fed), and potassium (potassium sulphate 48%K2O at 50 kg/fed).

The compost rates, superphosphate and potassium sulphate were applied with equipment of soil for planting. The quantities of N rates and ascorbic acid as a foliar spray were added three times, the first one after 20 days from planting and the second after 35 days from planting while the last one after 50 days from planting.

Measurement of plant growth and yield:

The samples from plants were taken at 90 days from planting. Plant height and plant dry matter as well as chlorophyll A, B and A+B content. Also, at harvest time 120 days from planting, head diameter, seed yield/ plant , 1000 seed weight and seed yield (kg/fed.) as well as N, P, K and oil percentage of sunflower seed were determined.

Chemical analysis:

Representative samples of seeds were dried under shading, and then dried again at 70 C until constant weight was recorded. The dry seed samples were ground and wet digested with H2SO4-HclO4 mixture. Nitrogen was determined using micro Kjeldahl, while phosphorous was determined calorimetrically using ammonium molybdate and ammonium metavanadate according to the procedure outlined by Ryan *et al*.(1996). Potassium was determined using the flame spectrophotometer method (Black, 1982). Seed oil percentage was determined according to A.O.A.C. (1990). Chlorophyll A, B and A+B content were determined by using the method described by Lichtenthaler, and Wellburn, (1983). Obtained results were statistically analyzed using M stat computer package to calculate F ratio according to Snedecor and Cochran (1980). Least significant differences method (L.S.D) was used to differentiate means at the 0.05 level (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

Plant height, plant dry matter and chlorophyll content at 90 days from planting

Data presented in Table (3) reveal that the highest significant values of plant height and plant dry matter as well as chlorophyll A, B and A+B content at 90 days from planting increased with increasing the addition of compost up to 4 t fed-1 compared to control treatment (without addition of compost) in both seasons. Similar trend was recorded for plant height by using medium rate of compost 2 t/fed., in the second season only. The increasing of such parameters may be due to the complete decomposition of compost and release of nutrients in the available form. Moreover, improvement in the physical, chemical and biological properties of soils as well as nutritional status due to the compost addition must have contributed to the higher yield. These findings confirm those obtained by **Convertini *et al.*, (2004)**; **Maiorana, *et al.*, (2005)** and **Louisa, and Taguiling, (2013)** Moreover, **Osman *et al.*, (2014)** stated that the adding compost can be improved the nutrients availability by aerating the soil, rising water holding capacity of soil and decreasing down soil pH which provides the favorable conditions for the growth and ultimately good crop harvest was achieved.

Increasing concentration of ascorbic acid up to 0.6 g L^{-1} lead to significant increase in plant height and plant dry matter as well as chlorophyll A, B and A+B content compared to without addition of ascorbic acid in both seasons. Also, the obtained data show that the foliar spray of ascorbic acid by any concentration gave the highest significant value of plant height at 90 days from planting in both seasons. Ascorbic acid application (vitamin-c) to plants stimulates their growth, thus, apart from their main role as coenzymes, it is not unlikely that vitamins may also play other independent roles in the biochemical processes of plants, repairing the harmful effects of unfavorable conditions. Ascorbic acid can scavenge the reactive oxygen species which are very damaging to the plant growth. It is a product of D-glucose metabolism which affects some nutritional cycle activities in higher plants and plays an important role in the electron transport system **(El-Kobisy *et al.,* 2005)**. Several studies have shown that ascorbic acid plays an important role in improving plant tolerance to abiotic stress(**Athar *et al.*,2008**) suggested that ascorbic acid could accelerate cell division and cell enlargement of treated plants. Foliar application of ascorbic acid was more effective in improving growth parameters of the treated plants, which was associated with increasing the water content and relative water content of leaves and reduction in transpiration rate. Moreover, **Azza *et al.* (2011)** stated that the promoting effect of ascorbic acid on total carbohydrates may be due to their important role of biosynthesis of chlorophyll molecules which in turn affected total carbohydrates content.

Table 3. Effect of compost rates and foliar spray of ascorbic acid on plant height (cm), dry matter (g/plant)and chlorophyll of sunflower at 90 days from planting

Treatments	Plant height at 90 days				Dry matter at 90 days				Chlorophyll A				Chlorophyll B				Chlorophyll A+B			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
Without A A	105.8	117.8	135.2	119.6	21.70	26.32	29.87	25.96	2.672	3.280	3.428	3.127	1.027	1.092	1.114	1.078	3.699	4.372	4.542	4.204
0.2 g/L A A	122.2	131.4	143.4	132.3	23.58	27.94	34.12	28.55	2.846	3.447	3.632	3.308	1.065	1.084	1.118	1.089	3.911	4.530	4.750	4.397
0.4 g/L A A	132.6	148.3	157.0	145.9	24.27	28.75	36.73	29.92	3.071	3.562	3.785	3.473	1.081	1.102	1.139	1.107	4.152	4.664	4.924	4.580
0.6 g/L A A	137.2	154.8	162.8	151.6	26.40	30.27	40.31	32.33	3.195	3.646	3.847	3.563	1.097	1.121	1.148	1.122	4.292	4.767	4.995	4.685
Mean	124.4	138.1	149.6		23.99	28.32	35.26		2.946	3.484	3.673		1.067	1.100	1.130		4.014	4.583	4.803	
L.S.D at 0.05																				
Compost rates	4.721				0.072				0.036				0.0356				0.062			
Ascorbic acid	12.45				0.237				0.031				0.031				0.054			
Interaction	21.57				0.409				0.054				0.054				0.094			
Second season																				
Without A A	118.6	125.6	139.6	127.9	22.13	28.72	32.44	27.76	2.813	3.322	3.486	3.207	1.044	1.107	1.136	1.096	3.857	4.429	4.622	4.303
0.2 g/L A A	140.2	153.9	158.8	151.0	23.97	30.18	34.92	29.69	2.974	3.496	3.661	3.377	1.072	1.118	1.159	1.116	4.046	4.614	4.820	4.493
0.4 g/L A A	147.8	161.2	167.6	158.9	25.12	32.03	39.05	32.07	3.138	3.605	3.803	3.515	1.090	1.133	1.167	1.130	4.227	4.738	4.970	4.645
0.6 g/L A A	151.0	168.3	172.4	163.9	26.69	33.38	41.47	33.85	3.211	3.692	3.912	3.605	1.111	1.147	1.173	1.144	4.322	4.839	5.085	4.749
Mean	139.4	152.2	159.6		24.48	31.08	36.97		3.034	3.529	3.715		1.079	1.126	1.159		4.113	4.655	4.874	
L.S.D at 0.05																				
Compost rates	8.019				0.148				0.001				0.001				0.001			
Ascorbic acid	14.47				0.172				0.001				0.001				0.031			
Interaction	25.06				0.297				0.002				0.002				0.054			

I_1 = without compost addition I_2 = 2 t fed^{-1} I_3 = 4 t fed^{-1} A A = Ascorbic Acid

Regarding the interaction effect between compost rates and concentration of ascorbic acid as a foliar spray on such parameters, results in most cases, demonstrate that the all parameters increased significantly by using the high concentration of ascorbic acid 0.6 g L^{-1} with higher rates from compost 4 t fed^{-1} in both seasons. Conversely, the lowest ones were obtained without compost addition and without foliar application of ascorbic acid in both seasons. Compost contains significant amounts of macro-nutrients (i.e., N, P and K). It is contain other components that can contribute significantly to an increase in sunflower plant height and plant dry matter as well as chlorophyll A, B and A+B content, including secondary nutrients and micro-nutrients. Also, ascorbic acid proved to be effective in alleviating harmful effect of water salinity (see Table 2) by alleviating the harmful effect of reaction oxygen species (ROS) caused by salinity by scavenging cytotox H_2O_2, and reacts non-enzymatically with other ROS singlet oxygen, superoxide radical and hydroxyl radical.

Head diameter (cm), seed yield/ plant (g), 1000 seed weight (g) and seed yield (kg fed^{-1})

The available data in Table (4) illustrate that the head diameter, seed yield/ plant, 1000 seed weight and seed yield (kg fed-1) of sunflower plant at harvest time 120 days from planting were improved significantly with increasing compost rates up to 4 t fed^{-1} compared without compost addition in both seasons, reached by 37.07, 28.45, 58.06 and 37.24% for 1st season and 37.68, 54.88, 29.88 and 32.86 % for 2nd season, respectively. This increment in sunflower seed yield may be due to the increase in 1000-seed weight. It seems probable, that the application of compost encouraged the accumulation of dry matter during the seed filling period of the sunflower. As compost of fact, it is used to improve soil properties, water retention capacity, draining, pH and better availability of soil microorganism. These results are in good agreement with those found by Abdel-Sabour *et al* (1999) who pointed out that compost addition significantly increased sunflower dry matter and seed yields, leaves chlorophyll content, oil and major nutrients such as N, P and K.

Results in Table (4) show that increasing the concentration of ascorbic acid (0.6 g L^{-1}) gave significant increases in values of head diameter, seed yield/ plant, 1000 seed weight and seed yield (kg/fed.) of sunflower plant compared to without ascorbic acid addition in both seasons, reached to 22.44, 32.10, 48.41 and 44.81% for 1st season and 23.94, 31.74, 46.89 and 40.22 % for 2nd season, respectively. Ascorbic acid has synergistic effects on growth, yield and yield quality of sunflower plant species. These compounds have beneficial effects on catching the free radicals or the active oxygen that produced during photosynthesis and respiration processes. Ascorbic acid could be considered natural and safety bio-regulator compounds which relatively in low concentrations exerted profound influences upon many physiological processes. Ascorbic acid (vitamin C) is one of the most important water soluble antioxidants in plants, acting as a modulator of plant development through hormone signaling and as coenzyme in reactions by which carbohydrates, fats and proteins are metabolized (Pastori *et al.* 2003).

Table 4. Effect of compost rates and foliar spray of ascorbic acid on head diameter (cm), seed yield/ plant(g), 1000 seed weight (g) and seed yield (kg fed-1) of sunflower

Treatments	head diameter (cm)				Seed yield/ plant(g)				1000 seed weight (g)				Seed yield (kg fed^{-1})			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
Without A A	9.360	11.28	12.77	11.14	17.39	19.32	24.58	20.43	26.33	28.87	32.45	29.22	627.5	768.3	841.6	745.8
0.2 g/L A A	9.840	12.05	13.82	11.90	19.37	21.85	28.12	23.11	30.12	31.96	37.28	33.12	692.4	848.2	921.8	820.8
0.4 g/L A A	10.55	12.87	14.96	12.79	20.81	23.92	34.57	26.43	32.44	33.57	41.53	35.85	778.1	963.7	1107	949.7
0.6 g/L A A	11.68	14.00	15.25	13.64	23.10	27.64	40.23	30.32	33.60	36.12	46.07	38.60	915.8	1057	1267	1080
Mean	10.36	12.55	14.20		20.17	23.18	31.88		30.62	32.63	39.33		753.4	909.3	1034	
L.S.D at 0.05																
Compost rates	0.1189				0.3602				0.3512				71.93			
Ascorbic acid	0.1657				0.2030				0.4248				56.00			
Interaction	0.2870				0.3516				0.7358				96.99			
Second season																
Without A A	9.430	11.55	12.87	11.28	18.22	19.87	25.12	21.07	27.18	29.13	33.88	30.06	671.3	803.5	897.7	790.9
0.2 g/L A A	10.00	12.37	14.10	12.16	19.95	22.03	28.73	23.57	30.74	32.18	38.15	33.69	723.7	792.2	943.6	819.8
0.4 g/L A A	10.68	13.10	15.23	13.00	21.57	24.71	35.08	27.12	33.10	33.96	42.00	36.35	846.0	984.3	1185	1005
0.6 g/L A A	11.93	14.32	15.68	13.98	23.93	28.25	40.66	30.95	33.87	36.75	48.17	39.60	977.3	1103	1247	1109
Mean	10.51	12.84	14.47		20.92	23.72	32.40		31.22	33.01	40.55		804.6	920.7	1069	
L.S.D at 0.05																
Compost rates	0.1242				0.2912				0.3226				24.94			
Ascorbic acid	0.2385				0.2971				0.5278				36.10			
Interaction	0.4131				0.5146				0.9142				62.53			

I_1 = without compost addition I_2 = 2 t fed^{-1} I_3 = 4 t fed^{-1} A A = Ascorbic Acid

Moreover, Emam *et al.* (2011) mentioned that ascorbic acid significantly increased the yield components of flax plants in terms of number of capsules/plant, number of seeds/capsule, seed yield/plant, seed yield/feddan as well as seed index compared with the control.

For the interacted factors under study effect on such parameters, data illustrate that the highest values of all parameters were recorded with foliar spray of ascorbic acid at the high concentration 0.6 g L^{-1} under compost application at 4 t fed^{-1} in both seasons. On the other hand, the lowest ones were observed without compost addition and without foliar application of ascorbic acid in both seasons. The compost addition to the soil resulted in creating favorable soil physical conditions (such as structure), which must have affected the solubility and availability of nutrients and thus the uptake of nutrients. Similar results were obtained by Convertini *et al.*, (2004); Maiorana, *et al.*, (2005) and Louisa, and Taguiling, (2013). In addition, ascorbic acid plays an important role in preserving the activity of enzymes. In this respect, Fatemi, (2014) found that the seeds of sunflower primed with various concentrations of ascorbic c acid proved to be effective in salinity tolerance at the germination stage of sunflower. In general, priming with 2 mM ascorbic acid was more effective than the other concentrations.

Nitrogen, phosphorus, potassium and oil percentage of sunflower seeds

Tabulated data in Table (5) show that the addition of compost rate at 4 t fed^{-1} gave the highest significant values of N, P, K and oil percentage of sunflower seeds compared without compost addition in both seasons. Also, results reveal that the application of 2 t fed^{-1} compost improved significantly P % of sunflower seeds in the second season only. Compost additions improve amounts of N, P and K and smaller amounts of other elements as well as organic matter content of soil. Products of organic decay such as organic acids and humus are thought to be effective in forming complexes with iron and aluminum compounds which are mainly responsible for P fixation in soils (El- Sherbieny *et al.* 2003). These results are in full agreement with those obtained by Helmy, and Ramadan (2009) who found that the highest values of sunflower yield, yield quality and its components as well as N, P and K uptake were obtained with the plants supplied with FYM + chemical fertilizer which were superior to the other treatments.

Increasing concentration of ascorbic acid up to 0.6 g L^{-1} produced a significant increase in N, P, K and oil percentage of sunflower seeds compared to check treatment in both seasons. Also, data reveal that the foliar spray of ascorbic acid at 0.4 g L^{-1} gave the highest significant value of P and K percentage of sunflower seeds in both seasons as well as N % in the second season only. Foliar application of antioxidants in the form of ascorbic acid has gained considerable attention as a probable approach to ameliorate the unfavorable effects of salinity stress on plants for improving sunflower plant growth, development and yield quantity (seed yield) and quality (N, P, K and oil percentage) of sunflower seeds. The positive effect of ascorbic treatments on N concentration could be explained by the finding of Talaat (2003) who concluded that the accumulation of nitrate by foliar application of ascorbic acid may be due to the positive effect of ascorbic on root growth which accordingly increased nitrate absorption. The promoting effect of the ascorbic acid on seed yield and yield components surely reflected on enhancing oil yields. Gamal El Din (2005) reported that oil percentage of sunflower seeds significantly increased by adding ascorbic acid. These results agreed with those obtained by Amin *et al.* (2008) who found that foliar application of ascorbic acid significantly increased P and K content in wheat grains up to 400 mg L -1 relative to their untreated controls. Also, ascorbic acid significantly increased N, P, and K content in leaves and seeds of sunflower plants compared with their controls (El-Gabas, 2006).

Table 5. Effect of compost rates and foliar spray of ascorbic acid on N, P, K and oil percentage of sunflower seed

Treatments	N%				P%				K%				seed oil %			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
Without A A	2.84	2.95	3.18	2.99	0.330	0.370	0.460	0.387	3.02	3.21	3.33	3.19	37.18	37.63	37.92	37.58
0.2 g/L A A	2.98	3.13	3.26	3.12	0.410	0.480	0.550	0.480	3.18	3.39	3.55	3.37	37.53	38.08	38.25	37.95
0.4 g/L A A	3.06	3.27	3.38	3.24	0.460	0.530	0.580	0.523	3.29	3.47	3.69	3.48	37.79	38.64	38.97	38.47
0.6 g/L A A	3.17	3.44	3.53	3.38	0.490	0.530	0.610	0.543	3.37	3.59	3.74	3.57	37.92	39.18	39.65	38.92
Mean	3.01	3.20	3.34		0.423	0.478	0.550		3.22	3.42	3.58		37.61	38.38	38.70	
L.S.D at 0.05																
Compost rates	0.062				0.036				0.101				0.196			
Ascorbic acid	0.077				0.045				0.144				0.177			
Interaction	0.133				0.077				0.249				0.307			
Second season																
Without A A	2.93	3.17	3.39	3.16	0.370	0.430	0.550	0.450	3.16	3.29	3.46	3.30	37.27	37.68	38.13	37.69
0.2 g/L A A	3.12	3.33	3.51	3.32	0.490	0.580	0.620	0.563	3.27	3.43	3.62	3.44	37.59	38.17	38.37	38.04
0.4 g/L A A	3.28	3.57	3.71	3.52	0.520	0.640	0.670	0.610	3.44	3.56	3.71	3.57	37.86	38.59	39.05	38.50
0.6 g/L A A	3.42	3.65	3.78	3.62	0.580	0.690	0.710	0.660	3.57	3.68	3.79	3.68	38.10	39.26	39.53	38.96
Mean	3.19	3.43	3.60		0.490	0.585	0.638		3.36	3.49	3.65		37.70	38.42	38.77	
L.S.D at 0.05																
Compost rates	0.080				0.062				0.108				0.280			
Ascorbic acid	0.137				0.070				0.144				0.268			
Interaction	0.237				0.121				0.249				0.464			

I_1 = without compost addition I_2 = 2 t fed^{-1} I_3 = 4 t fed^{-1} A A = Ascorbic Acid

Respecting to the interacted factors under study effect on such parameters, results show that the all parameters were improved significantly with foliar spray of ascorbic acid at the high concentration 0.6 g L^{-1} under compost application at 4 t fed^{-1} in both seasons. Similar trend for P and K % were recorded by foliar application with any concentration of ascorbic acid under both rates from compost in both seasons. On the other hand, the lowest ones were observed without compost addition and without foliar application of ascorbic acid in both seasons. Adding compost to the soil caused remarkable improvement of different growth characters, yield and chemical constituents of sunflower plant. This may be due to the benefits of compost supply to the soil on the basis of anion replacement or competition between humate and phosphate ions on the active sites of adsorbing surfaces. In this connection, Louisa, And Taguiling, (2013) found that Organic matter is the measure of carbon based materials in the compost. It is an important source of carbon that improves soil and plant efficiency by improving soil physical properties, providing a source of energy to beneficial organisms, and enhancing the reservoir of soil nutrients. Compost application to sandy soil significantly increased both dry matter production of sepals and number of roselle plant fruits (Kandil *et al.*, 2002). Also, foliar spray of ascorbic acid might enhance the organic acids excreted from the roots into the soil and consequently improve the solubility of most nutrients which release slowly into the rhizosphere zone. Moreover, Sadak, Mervat and Mona Dawood, (2014) concluded that foliar application of ascorbic acid could play an enhancement role and alleviate the harmful effect of salinity stress on many metabolic and physiological processes of three flax cultivars that reflected in increasing seed yield quality and quantity.

So, compost addition and foliar application of ascorbic acid significantly increased sunflower dry weight, seed yield, oil content, chlorophyll and major elements (NPK). Organic fertilization and foliar application of ascorbic acid are very important method to provide the plants with their nutritional requirements. These means that compost and ascorbic acid proved to be effective in alleviating harmful effect of salinity by alleviating the harmful effect of reaction oxygen species (ROS) caused by salinity by scavenging cytotox H_2O_2, and reacts non-enzymatically with other ROS singlet oxygen, superoxide radical and hydroxyl radical.

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