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ROLE OF HUMIC, ASCORBIC ACIDS WITH OR WITHOUT COMPOST TO IMPROVE NUTRIENTS CONTENT, YIELD COMPONENTS AND SEED QUALITY OF SESAME

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ABSTRACT

A field trial was conducted at Ismailia Research Station during the two successive summer seasons (2012 and 2013) seasons. The objective of this research was aimed to study the effect of organic matter (compost) as soil application, humic and ascorbic acids as foliar application individually in two rates 1.5 g /L and 3 g/L for each one and their combinations with compost on growth parameters, yield, its components, seed quality and quantity of sesame C.v. Sohag 1. Results indicated that foliar application of humic and ascorbic acids individually or combined with compost application markedly increased most of growth parameters, i.e., germination %, seedling vigor, plant height, fruiting zone length, No. of capsules /plant, seed weight /plant 1000-seed weight (g) and seed yield (kg/fed) compared with untreated plant . Beside of that, compost application , foliar spray with humic or ascorbic acids led to significant increase in protein %, oil %, carbohydrate %, P %, K % and concentrations of micronutrients (Fe ,Zn ,Mn and Cu). Also, significant increase was found in protein, oil yields, P and K. The highest values were 233.61, 635.09, 5.72 and 43.4 (kg / fed) for protein, oil yield, P and K, respectively, which achieved by using ascorbic acid only as foliar spray at (1.5 g/L). The same trend was observed in micronutrient contents and highest values were 459.66, 50.46, 321.21 and 13.83 (g/fed) for Fe, Zn, Mn and Cu, respectively. In combined treatment between compost and humic acid at the rate (1.5 g/L) the highest values were 161.49, 473.97, 3.98 and 31.81 (Kg/fed) for protein, oil yields, P and K contents highest values were 379.67, 43.85, 243.31 and 9.72 (g /fed) for Fe, Zn, Mn and Cu contents.

Keywords: Compost, humic acid, ascorbic acid, foliar spray-sesame plant.

INTRODUCTION

Sesame (*Sesamum indictum, L*) is one of the most important oil crops in Egypt. The crop is grown for its seeds, which contain 50-60% oil, 8% protein 3.2% crude fiber, 18% carbohydrate, 5.7% ash and it is very rich in minerals such as Ca, P and vitamin E (Dasharath *et al* ., 2007). Also, sesame oil has a very high level of unsaturated acids, which is assumed to have reducing effect on plasma cholesterol, as well as on coronary heart disease (Agboola, 1979). Sesame seeds have a positive amino acid structure, high level of methionine (2.32 to 3.77 g/16g N) and tryptophan (1.03 to 1.95g/ 16 g N), oxalate content varied from 475.32 to 967.19 mg/100g, while the range of oil content was 32.00 to 50.36 and low level of lysine; this makes it an excellent protein complement compared to other plant proteins. Neelan *el al*., (2007) found that sesame genotypes contained high value of protein content in the range of 18.60 to 27.57%. The moisture content was in the range of 3.14 to 4.40% and ash content ranged from 4.20 to 6.20%.

There is evidence of a positive effect of humic acid substances on the growth of various groups of microorganisms. There is also evidence that some of the humate materials contain large populations of Actinomycetes (microorganisms that share the properties of both fungi and bacteria). They are capable of degrading a wide range of substances including celluloses, humic celluloses, proteins, and lignin. Humic acid is not a fertilizer but also is considered as a compliment to fertilizer, mackowiak *et al*., (2001). Padem *et.al.* (1999) and Neri *et. al.,* (2002) reported that humic acid as foliar sprays enhanced growth, nutrient uptake and yield and improved the quality of the production of some crops. Porass et al (2010) found that application of half of the recommended dose of nitrogen combined with humic acid and with Azospirillum led to highest increase in number of branches, number of capsules, 1000-seed weight, seed yield and oil content for Giza 32 and shandweel-1 sesame genotypes. Significant increase was observed in protein, P, K and oil % for sesame seeds and yield of protein when foliar spray with humic acid or/ amino acid applied to gypsum application (*Eisa, 2011).*

Ascorbic acid is one of the most important metabolites acts as antioxidant and it has been also associated with several types of biological activities in plant, as a donor/ acceptor in electron transport and as enzyme co-factor (Conklin, 2001). *Bolkhina et al (2003)* pointed that ascorbic acid is the most abundant antioxidant which protects plant cell. Ascorbic acid is currently considered to be a regulator on cell division and differentiation and added that ascorbic acid is involved in a wide rage of important functions as antioxidant defence, photoprotein and regulation of photosynthesis. Application of ascorbic acid in addition to hydropriming of seeds may be enhance and increase germination under salt stress (Tavili *et al* 2009).

Soil organic matter is considered as a major component of soil quality because it contributes directly or indirectly to many physical, chemical and biological properties. Thus, soil amendment with composts is an agricultural practice commonly used to improve soil quality and also to manage organic wastes (Ana, *et al* 2006). The beneficial effects of compost on crop production and soil properties are directly related to the application rate of manure compost (Wong *et al*., 1999).

Compost amendments can modify the microbial community composition and as a result, enhance the competition and /or antagonism among microbes, leading to a decrease in plant pathogens activity (Hoitink and Boehm, 1999 and Steinberg *et al*., 2004). Sandy soils cover wide areas in Egypt; therefore reclamation of these soils is the main target for the horizontal expansion of our cultivable land. Unfortunately, sandy soils have very poor hydrophysical and nutritional values. Thus, the use of soil organic amendments is of vital importance to improve physical, chemical and nutritional characteristics of these soils.

The objective of this investigation was to study the effect of soil organic amendments on nutrients and yields and seeds quality for sesame plant.

MATERIALS AND METHODS

Tow field trials were conducted at Ismailia Agricultural Research Station during the summer 2012 and 2013 seasons on loamy sand soil. The aims of this investigation was aimed to study the effect of compost as soil application, humic and ascorbic acids as foliar spray solely at two rates (1.5 g/L) and (3 g/L) of each one and their combination on growth, yield, it's components and seed quality of sesame plant Varity Sohag 1. Sesame seed was planted on 2ndof May in 2012 and 5th of May in 2013. Humic and Ascorbic acids were added as foliar spray at three times after 21, 45 and 60 days from planting. The compost was added as soil application and mixed with the soil before cultivation. Plants were fertilized by N, P and K according to the general recommendations in the proper time. The treatments were as follows:

1- Control (no treatment) 6-Compost at rate of 10 ton fed^{-1}
2-Humic acid (1.5g/l) 7-Humic (1.5 g/l) + compost
3-Humic acid (3g/l) 8- Humic (3g/l) + compost
4-Ascorbic acid (1.5g/l) 9-Ascorbic acid (1.5 g/l) +compost
5- Ascorbic acid (3g/l) 10- Ascorbic acid (3g/l) +compost

The main physical and chemical properties of the cultivated soil before planting were determined according to the methods described by Jackson (1976) .

The obtained data of the soil physical and chemical properties were recorded in Table (1).

Table (1): some physical and chemical properties of experimental soil.

<table>
<tr><th>Coarse sand (%)</th><th>Fine sand (%)</th><th>Silt (%)</th><th>Clay (%)</th><th colspan="2">Soil texture</th><th colspan="2">OM (%)</th><th>CaCO$_3$ (%)</th></tr>
<tr><td>11.73</td><td>75.39</td><td>2.46</td><td>10.42</td><td colspan="2">Loamy sand</td><td colspan="2">0.45</td><td>1.72</td></tr>
<tr><td rowspan="2">pH (1:2:5)</td><td rowspan="2">EC (dS/m)</td><td colspan="4">Cations (meq/l)</td><td colspan="3">Anions (meq/l)</td></tr>
<tr><td>Ca^{++}</td><td>Mg^{++}</td><td>Na^{+}</td><td>K^{+}</td><td>HCO^{-}_3</td><td>Cl^{-}</td><td>SO^{--}_4</td></tr>
<tr><td>7.94</td><td>1.46</td><td>2.93</td><td>1.57</td><td>9.32</td><td>0.78</td><td>1.44</td><td>7.80</td><td>5.36</td></tr>
<tr><td colspan="9">Available nutrients in soil</td></tr>
<tr><td colspan="3">Macronutrients (mg/kg)</td><td colspan="6">Micronutrients (mg/kg)</td></tr>
<tr><td>N</td><td>P</td><td>K</td><td colspan="3">Fe</td><td>Mn</td><td colspan="2">Zn</td></tr>
<tr><td>33.47</td><td>1.94</td><td>177</td><td colspan="3">1.68</td><td>2.96</td><td colspan="2">0.69</td></tr>
</table>

Compost was plowed 25 days before sesame transplanting at the rate of 10 ton fed^{-1}. The preparation of compost was done by using two ton of straw crop residuals (rice straw, maize stover and faba bean straw), air – dried and made into 5 – 10 layers, each about 50cm thick. Application of 300 kg/ pile of farmyard manure was added to enhance microorganism activity, and it was then provided with a sufficient quantity of water. Every 21 days the heap of crop residuals was turned over until it became well decomposed. Chemical composition of the used compost is shown in Table (2). The compost analysis was done according to the standard methods described by Brunner and Wasmer (1978)

Table (2): Chemical properties of compost.

Moisture content %	EC dSm^{-1} (1:10)	pH	C	C/N	O.M	N	P	K	Fe	Mn	Zn	Cu
		(%)							($mgkg^{-1}$)			
25	3.19	7.41	32	16.93	43	1.89	0.63	2.47	236	86	128	37

Chemical composition of the used humic acid is shown in Table (3).

Table (3): Chemical properties of used humic acid.

pH	EC (dSm^{-1})	O.M. (%)	Macronutrients (%)			Micronutrients ($mg\ kg^{-1}$)		
			N	P	K	Fe	Mn	Zn
7.83	1.71	75	2.28	0.35	3.75	418	260	217

The yield was harvested on 10th of September in 2012 and 15th of September in 2013. In both seasons, each experiment was carried out in a complete randomized block design with three replicates. The growth parameters were the germination %, shoot length, radical length, fresh weight of seedling, EC, carbohydrate %, plant height, fruit zone length ,N. of capsules, seed weight /plant (g), 1000-seed weight (g), seed yield (Kg/fed). At Seed Technology Research Institute during 2012 and 2013 laboratory experiment were carried out to assess seed quality from field experiments. Germination percentage was expressed by the percentage of normal seedling at the end of testing period according to the International Seed Testing Association I.S.T.A (1985). Three replicates used at germination in 25C^{o}for 8 days. Normal seedling was counted expressed as germination percentage at final count. Ten normal seedlings from each replicate were taken to measure shoot and radical length (cm) and seedling dry weight according to Kirshnasamy and Seshu (1990). For Electrical Conductivity (µscm^{-1}/g^{-1}) 50 seeds /replicate were weight and soaking in 250 ml of deionized water at 25C^{o} for 24 hours. Electrical Conductivity of seeds leach was estimated according to I.S.T.A.(1985). For chemical analyses samples of seeds were ground and 0.5 g powder of each was digested by concentrated digestion mixture of H_2SO_4/$HClO_4$ acids according to Sommers and Nelson (1972). Nitrogen was determined by using micro Keldahl, according to Jackson (1976). Phosphorus was determined Spectrophotometrcally using ammonium molybdate stannous chloride method according to Chapman and Pratt (1978). Potassium was determined by a flame photometer, according to Page *et al* (1982). Oil of sesame seeds was determined according to A.O.A.C. (1990) by using Soxhelt apparatus and petrolium ether as solvent. Fe, Zn, Mn and Cu were determined by using atomic absorption (model GBC 932). All data were subjected to statistical analysis according to Snedecor and Cochran (1990). The least significant differences (LSD at 0.05) were used to compare the treatments means.

RESULTS AND DISCUSSION

The effect of applied treatment on:
Morphological characters and yield components.

Growth parameters as affected by foliar spray of humic acid, Ascorbic acid and compost individually or in combination between them are showed in Table (4). All growth parameters, i.e. germination percentage, shoot and radical length, fresh weight of seedling, EC and carbohydrate% in seeds were significantly affected by applying different treatments compared with the control treatment. The highest values of germination %, shoot length and fresh weight of seedling were 95.0 %, 3.43(cm) and 0.86 (g), respectively, under 1.5g/L ascorbic acid individually compared to control (69.0%). The same trend was observed in EC test and the lowest values were (10.16 dSm^{-1}) under 1.5g/L ascorbic acid lonely compared to control (19.16 dSm^{-1}) .The lowest value of germination % was (72%) under humic acid (3g/L) combined with compost.

Table 4: Seedling vigour and carbohydrate % as affected by foliar spray with humic acid, Ascorbic acid and compost application for sesame plant as (combined the two seasons 2012-2013).

Treatments	Germination%	Shoot length (cm)	Radical length (cm)	Fresh weight of seedling	EC seeds (dSm^{-1})	Carbohydrate %
Control	69.00	2.233	2.900	0.490	19.167	32.200
Hu (1.5gL)	75.00	2.600	3.233	0.533	15.667	33.500
Hu (3g/L)	89.00	3.067	5.800	0.667	11.167	31.600
Mean	77.67	2.630	3.980	0.560	15.330	32.430
As (1.5g/L)	95.00	3.433	5.333	0.867	10.167	32.700
As (3g/L)	86.00	2.733	4.900	0.720	11.500	32.633
Mean	86.22	2.93	4.740	0.720	12.330	32.590
Com	73.00	2.233	3.833	0.503	12.233	31.900
Com+Hu(1.5gL)	77.00	2.867	2.867	0.800	16.500	34.553
Com.+Hu(3g/L)	72.00	2.833	3.133	0.790	16.900	32.467
Mean	74.50	2.850	3.000	0.800	16.700	33.510
Com.+As. (1.5gL)	81.00	3.367	3.533	0.803	14.533	32.000
Com.+As(3g/L)	81.00	2.967	4.833	0.583	16.700	34.433
Mean	81.00	3.170	4.180	0.69	15.620	33.220
$LSD_{0.05}$	2.567	0.417	0.335	0.042	0.629	0.527

Hu: humic – Ascorbic acid: Asc – Com: compost

Moreover, the combined treatment between compost and humic acid at rate(1.5g/L) had significant increase and react rend had 77% over the applied compost alone, while, the combined treatment between compost and both rates of ascorbic acid has not appreciable difference or trend among the different treatments. Seed vigour is not a single measurable property. Wang *et al*. (1994) reported that CD (Controlled Deterioration) and EC test were more sensitive and accurate for predicting red clover storability and field emergence than the standard germination and germination index. Almansouri *et al.* 2001 found that seed germination and rapid germination are usually essential process in seedling numbers than those results in higher seed crops. Germination is the first step in the plant growing which is one of the critical stages in the life cycle of plants and is a key process in germination seed treatment *(*De Villiers *et al., 1994)*. Similar findings were obtained by Tabatabaei and Naghihalghora *(*2013) who stated that highest germination percentage, germination index; normal seedling percentage, dry weight and seedling length were attained from priming with ascorbic acid in control condition. Afzal *et al. (*2006) reported that ascorbic acid and salicylic acids caused reduction of effective salinity stress on germination and seedling growth of wheat. Moreover, several reports indicate that a large amount of ascorbic acid is utilized during the initial stage of germination by both zygotic and somatic embryos (Stasolla and Yenung, *(2001).* These results are in agreement with those obtained by (Tavili *et al* .2009, Airin and Mohammadi 2013) and (Liaz et *al.* 2013) who found that the maximum value of shoot length was recorded in plants sprayed with 40mg/l ascorbic acid. Concerning the effect of ascorbic acid, it is currently to be regulators on plant growth and development owing to their effects on cell division and differentiation .These results are in line with those obtained by Smirnoff (1996) who mentioned that Ascorbic acid has been implicated in regulation cell division. In this connection, the author pointed that cell wall Ascorbic acid and cell wall located Ascorbic acid oxidase has been implicated in control of growth, high Ascorbic acid oxidase activity is associated with rapidly expanding cells. Accordingly, these increments in growth parameters by Ascorbic acid, treatments might be attributed to the postulation of Shaddad *el al*. (1990) assumed that the effect of ascorbic acid on plant growth was may be due to the substantial role of ascorbic acid in many metabolic and physiological processes. Also, Hanafy Ahmed (1996) on lettuce found that foliar application of ascorbic acid had positive effects on growth parameters. Robinson (1973) reported that ascorbic acid acts co-enzymatic reaction by which carbohydrate; protein are metabolized and involved in photosynthesis and respiration. In radical length, the highest value was (5.80 cm) by using 3g/L humic acid individually compared with the control treatment (2.90 cm). On the other hand, in carbohydrate %, the values ranged from (31.6% to 34.55%) and the highest values were (34.55 % and 34.43%) under compost with 1.5g/L humic acid and 3g/L ascorbic acid respectively, compared to the control (32.20%). These results are in agreement with those obtained by Chen *et al.* (2004) who reported that humic acid and fulvic acid increased the fresh and dry weight of plants. In addition, Mackowiak *et al.* (2001) found that humic acid increased seed germination and improve root growth. These obtained data were expected, science humic acid is a commercial product contains many elements which improve the soil fertility and increase the availability of nutrients their uptake and consequently increase plants growth and yield. It used to ameliorate or reduce the negative effect of salt stress. These results are in agreement with those obtained by Abdel-AL *et al*. (2005) on onion and Hafez (2003) on spinash where they reported that humic acid application led to a significant increase in soil organic matter which improves plant growth and crop production. As for the effect of the combined treatments, it is clear from data in Table(4) that applied compost either alone or in combination with humic and ascorbic acids led to an increase in the above growth characters over the control but it was noticeable in case of the combined treatments in different rates compared with applied compost only .

Referring to results in Table (5), it could be observed that a marked increase in plant height, fruiting zone length (cm), number of caps, seed weight of plant, 1000-seed weight and seed yield by applying different treatments compared to the control.

Table 5: Plant height(cm) , fruit zone length(cm),yield and yield components of sesame crop as affected by foliar spray with humic acid, ascorbic acid and compost application (combined data of the two seasons (2012-2013).

Treatments	Plant height (cm)	Fruit zone length (cm)	No. of Caps	Seed weight /plant(g)	1000 seed-weight(g)	Seed yield (kg/fed)
Control	143.00	78.00	86	9.20	1.96	460.00
Hu. (1.5gL)	172.66	84.33	132	18.83	2.93	816.66
Hu. (3g/L)	165.33	81.66	111	22.19	4.50	1060.66
Mean	169.00	83.00	122	20.51	3.72	938.66
As (1.5g/L)	176.00	97.00	183	26.17	4.96	1216.66
As(3g/L)	170.33	87.33	145	23.18	3.43	1055.00
Mean	173.165	92.17	164	24.68	3.20	1165.83
Com	136.33	62.66	91	15.05	2.73	640.00
Com+Hu	163.66	72.66	96	20.37	4.00	926.33
Com.+Hu	171.66	73.66	93	16.81	2.26	719.00
Mean	167.66	73.16	94	18.59	3.13	822.67
Com.+As (1.5g/L)	150.33	74.33	100	16.99	2.46	739.33
Com.+As (3g/L)	151.33	74.00	101	18.06	2.26	845.00
Mean	150.83	74.17	101	17.53	2.36	792.17
$LSD_{0.05}$	14.888	16.855	27.552	6.01	0.536	59.322

***Hu: humic – Ascorbic acid: Ascorbic acid – Com: compost**

Results showed that the highest values of plant height and fruiting zone length were 176 cm and 97 cm, respectively, under ascorbic acid application lonely at (1.5 g/l) and (3 g/L) while, the lowest value was 62.66 cm when compost was applied alone. Moreover, the effect of compost application, foliar spray by humic and ascorbic acids on number of capsules/plant ,seed weight (g) ,1000 seed weight (g), seed yield (Kg/ha) are presented in Table (5). Results appear significant increments in the above yield components by all treatments over control. Results revealed that foliar application of ascorbic acid with (1.5g/L) recorded the highest values of number of capsules/plant, seed weight/plant (g), 1000-seed weight(g) and seed yield (kg/ha) which were 183, 26.17(g),4.96(g) and 1216.66 (Kg/fed) respectively . These findings are confirmed by the results undertaken by Al-Qubaie(2002) who stated that ascorbic acid has an auxinic action and synergistic effect on the biosynthesis of carbohydrate and controlling the incidence of most fungi on plants which making them in vigorous state and positively reflects on seed yield.

In this connection, ascorbic acid plays important roles in plants, such as protective role against reactive oxygen species that are formed from photosynthesis and respiratory process. Ascorbic acid is linked to cell growth, being involved in the cell cycle and other mechanisms of plant cell growth and division, as well as acting as a co- factor for many enzymes (Lee and Kader, 2000). As for the combined treatments, the highest value of plant height was 171.66 (cm) with applied compost plus humic acid (3g/L) compared with the control (143 cm). Also the results refereed to the highest number of capsules and fruiting zone length achieved by treating sesame plants with compost application combined by foliar spray of humic and ascorbic acids at two rates for each. Padem (1999) and Neri *et al*., (2002) reported that humic acid as foliar sprays enhanced growth and yield and nutrient uptake of some crops. Zancani *et al (2009)* showed that the molecular characterization of the composition of humic acid material is essential for the evaluation of the possible mechanisms by a molecular influence on plant growth. The application of recommended doses of mineral fertilizers with compost application, humic and ascorbic acids as foliar spray increased the uptake of nutrients by plants and consequently increased growth rate. However, the beneficial effect of those interactions could be attributed for enhancing of easily nutrients release into soil solution and to encourage their penetration through plant roots, as well as to develop antagonistic impacts toward pests and plant diseases (Ho and Hwan, 2000). Maximum seed weight / plant (g), 1000- seed weight (g) and seed yield (kg/ha) reached to 20.37(g), 4.00(g) and 926.33 (kg/ha), respectively, by using compost + humic acid (1.5g/L). In this respect, Khaled *et al. (*2012) concluded that on sesame plant, compost and humic acid could be used as integrated plant nutrition for producing higher sesame yield quantity and quality. These results are agreement with those obtained by Eisa (2011) reported that the highest yields for sesame seed achieved upon treating by foliar spray with (6g /L) humic acid. Porass *et al.(2010)* found that humic acid with nitrogen and Azospillium increased 1000seed weight, number of capsule and seed yield. Singaravel *et al.,* (1993) found that the seed yield of sesame increased with increasing the addition rate of humic acid from (0-40 kg/ha) sprayed on the soil surface. Also, Maral (2012) on wheat found that using humic acid as foliar spray significantly increase seed yield, straw yield, biological yield and harvest index. These results are well in agreements with those of Bakry *et al.* (2013) in wheat plant. The recorded values in the interaction treatments were still higher than control and compost alone in the two growing seasons.

The effect of applying treatment on macronutrients, oil and protein content in seeds.

Results presented in Table (6) showed that protein (%), oil (%), P%, and K% in seeds were pronounced responses due to addition of humic and ascorbic acids as foliar spray lonely and with compost soil application compared to the control. The highest values of protein% was 19.9% which recorded by combined treatment between compost and humic acid at rate (3g/L) and was 53.36 % for oil % recorded by compost combined with ascorbic acid at rate of (1.5g/L) while, P % was 0.49% recorded by ascorbic acid solely at rate of (3g/L) and K% was 3.73% recorded by applied compost alone. The lowest protein (%) was (16.73 %) under 1.5g/L humic acid, (50.30%) under compost, (0.43%) under compost +1.5g/L humic acid and (0.3 %) under humic acid for protein %, oil %, p% and K %, respectively compared to the control.

Table (6): Protein %, Oil %, P % and K % in sesame seeds as affected by foliar spray with humic acid, ascorbic acid and compost application (combined analysis of two seasons 2012-2013).

Treatments	Protein %	Oil %	P %	K %
Control	17.00	49.20	0.42	3.13
Hu(1.5g/L)	17.23	50.40	0.46	3.00
Hu (3g/L)	17.80	51.16	0.44	3.16
Mean	17.52	50.78	0.45	3.08
As (1.5g/L)	19.20	52.36	0.47	3.56
As(3g/L)	18.63	53.06	0.49	3.26
Mean	18.92	52.71	0.48	3.41
Com	18.60	50.30	0.47	3.73
Com+Hu (1.5g/L)	17.46	51.30	0.43	3.43
Com.+Hu (3g/L)	19.90	52.03	0.44	3.50
Mean	18.68	51.67	0.44	3.47
Com.+As (1.5g/L)	19.40	53.36	0.45	3.33
Com.+As (3g/L)	18.60	52.13	0.45	3.50
Mean	19.00	52.75	0.45	3.42
$LSD_{0.05}$	0.209	0.209	0.015	0.149

***Hu: humic – Ascorbic acid: Ascorbic acid – Com: compost**

These results are in agreement with those obtained by Antoun, *et al*. (2010), Moussa *et al*. (2006) and Nasef, *et al*., (2009). In this connection Bama and Sevekumori (2001) reported that Humic acid increased crude protein content and mineral nutrition (P, K, Ca, Mg, Zn, Cu, Fe and Mn) of amaranths. Reddy and Priya (1991) concluded that oil content was positively correlated with number of branches, number of capsules and seed yield of sesame crop. Concerning the effect of humic acid, it improves physical, chemical and biological properties of the soil and influences plant growth. In this concern, Hussin and Hassan (2011) indicated that humic acid is important soil components which improve nutrient availability and have impact on other important chemical, biological and physical properties of soils. Also, it was stated that foliar application of humic acid increased the uptake of P, K, Mg, Na, Cu and Zn. Mahmoud (2006) found that humic acid individually increased oil and protein contents in peanut crop. Moreover, Singaravel, *et al*., (1993) found that the humic acid contains auxins, which influence cell division and stem that gave the cell walls the ability to expand. So, humic acid can contribute in increasing seed sesame yield and improving both its protein and oil contents. As regarding to the effect of foliar spray of ascorbic acid, on N, P and K concentrations, it is noticed from the results that, the percentage and the uptake of N, P and K, gradually increased by applying ascorbic acid as foliar spray compared with the untreated plant .Besides ,the induced effect of Ascorbic acid on oil % may be due to that vitamin is recognized to be coenzyme involved in specific biochemical reaction in plants such as oxidative and non-oxidative decarboxylations **(**Robinson ,1973). The effect of foliar application of ascorbic acid on N, P, K concentration it is worthy to be noticed from the results that the percentage and the uptake of N, P , and K gradually increased by increasing Ascorbic acid levels compared with the untreated plant. This increment in N concentration by ascorbic acid treatments could be explained by which findings by Talaat (2003) who showed that the accumulation of nitrate by ascorbic acid as foliar application may be due to the positive effect of ascorbic acid on root growth which consequently increased nitrate absorption; as for the effect of compost, Abdel-Rahman *et.al*. (2004) found that application of compost decreased soil pH (from 9.75 to 8.22), EC and ESP of the soil. Rebeka (2006) found that compost fertilizer extracts lowered pH, salinity and K concentration while, relatively raised N, P, Ca and Mg concentrations when was used as a source of nutrients for plant growth. It can be noticed that the obtained increases in macronutrients in seeds may be due to the availability of them in the soil as a result of decreasing soil pH caused by the action of compost application. Generally, the increase in total N, P and K may be due to the net loss of dry mass as loss of organic materials during composting. Moreover, total N can also be increased by activates all associative N- fixing bacteria at the end of composting process.

Micronutrients concentration in seeds.

The effect of the used treatments on Fe, Zn, Mn and Cu concentration in sesame seed, are presented in Table (7). Results cleared that application of all treatments caused marked increases in almost micronutrients concentrations of Fe, Zn, Mn and Cu (mg/Kg) in sesame seeds. The highest concentrations of Fe and Zn in sesame seeds were 412.0 and 46.26 mg/kg, respectively recorded by humic acid lonely at the rate of (1.5g/L). While, for Mn and Cu, were it 268.0 and 11.50 mg /kg, respectively by using ascorbic acid at rate of (3g/L).

Table 7: Micronutrient concentrations for sesame seeds as affected by foliar spray with humic acid, ascorbic acid and compost application (combined data of two seasons).

Treatments	Fe (mg kg^{-1})	Zn (mg kg^{-1})	Mn (mg kg^{-1})	Cu (mg kg^{-1})
control	410.10	41.43	250.66	9.40
Hu(1.5g/L)	412.00	46.26	256.00	9.70
Hu (3g/L)	398.00	44.30	260.33	11.16
Mean	405.00	45.28	258.17	10.43
As. (1.5g/L)	378.00	41.36	264.00	11.36
As (3g/L)	411.00	44.76	268.00	11.50
mean	395.00	43.06	266.00	11.43
Com	399.33	45.26	267.00	10.30
Com+Hu(1.5g/L)	410.00	47.33	262.66	10.50
Com.+Hu (3g/L)	397.00	41.70	265.00	10.20
Mean	403.00	44.16	263.83	10.35
Com.+As(1.5g/L)	401.00	46.66	260.33	10.10
Com.+As (3g/L)	400.66	45.40	268.00	10.50
Mean	400.83	46.03	264.17	10.30
LSD 0.05	**1.66**	**0.16**	**0.98**	**0.19**

Hum: humic – Ascorbic acid:– Com : compos

The superiority of combined treatment between compost and humic acid at rate (1.5g/L) for Fe and Zn were 410.0 and 47.33 mg/kg, respectively. As for Mn and Cu the maximum values were 268.00 and 10.50 mg/kg which recorded by compost combined with ascorbic acid at rate (3g/L).

From aforementioned results, it could be concluded that Fe, Mn, Zn and Cu concentration tended to increase in seeds of sesame plants. This may be mainly due to their accumulations in the added materials which in turn enhance positively affecting the availability of these elements. These findings are in agreement with those obtained by Zorbas *et al*., (2002) and Khaled and Fawy (2011) and Antoun *et al*., (2010). It is worthy to mention that the content of the studied available micronutrients Fe, Mn, Zn and Cu generally were within sufficient limits according to FAO (1992).

Sesame seeds quality:-

Results presented in Table (8), means of both seasons, show pronounced increase in protein yield, oil yield, P, K, content due to all treatments compared with the control. The increases in oil %, protein % P% and K% were already reflecting on the protein yield, oil yield, P and K contents. The highest values were 233.61 , 635.09, 5.72 and 43.4 (kg/fed) for protein yield, oil yield P content and K content respectively, which were achieved by treating plants with ascorbic acid alone as foliar spray at rate (1.5g/L). It is worthy to mention that a significant increase was achieved in the above chemical characters by using both of humic and ascorbic acid individually as foliar application compared with applying compost alone or in combination treatments. In this concern, the increase in P concentration by spraying ascorbic acid may be attributed to the postulation of Hanafy Ahmed (1996) reported that foliar spray with ascorbic acid might increase the organic acids excreted from the roots into the soil and consequently increase the solubility of most nutrients which release slowly into the rhizosphere zone where it may be utilized by the plants and reflect on protein yield.

Table 8: Protein yield, oil yield, P content and K content for sesame seeds as affected by foliar spray with humic acid, Ascorbic acid and compost application as (combined data of two seasons).

Treatments	Protein yield (Kg/fed)	Oil yield (Kg/fed)	P content (Kg/fed)	K content (Kg/fed)
Control	79.07	226.08	1.93	14.39
Hu(1.5g/)	136.64	410.78	3.75	24.50
Hu (3g/L)	188.76	539.42	4.73	33.24
Mean	162.70	475.10	4.24	28.87
As (1.5g/L)	233.61	635.09	5.72	43.40
As (3g/L)	196.58	559.15	5.20	34.46
Com	119.04	321.05	3.01	23.89
Mean	157.81	440.10	4.11	29.18
Com+Hu(1.5g/)	161.49	473.97	3.98	31.80
Com.+Hu(3g/L)	143.08	373.64	3.16	25.17
Mean	152.29	423.81	3.57	28.49
Com.+As(1.5g/)	143.49	393.32	3.37	24.64
Com.+As(3g/L)	157.17	440.24	3.83	29.57
Mean	150.33	416.78	3.60	27.11
LSD 0.05	10.08	31.94	0.26	2.25

Hum: humic – Ascorbic acid: Asc – Com : compost

Talaat (2003) on sweet pepper detected that ascorbic acid used as foliar application increased the content of macronutrients (N, P and K). Furthermore, the combination between compost and ascorbic acid levels were almost positive for the percentage and uptake of N, P and K. Therefore, it can be postulated that Ascorbic acid treatments might increase rate of transformation of free amino acids into protein. On the other hand, for combined treatments , the highest values of protein, oil yield , P and K content were 161.49 , 473.97 , 3.98 and 31.81 (kg/fed), respectively which achieved by combined treatments between compost application and foliar spray with (1.5g/L) humic acid. These results are in agreements with those obtained by Khaled *et al*.(2012) Eisa (2011) who show that increasing sesame seed quality i.e. proteins% P% , K% , and oil % , proteins yield, P and K content and oil yield (kg/fed) were found due to foliar spray of humic acid.

The all combined treatments caused more pronounced effect on protein, oil yields, N, P, Fe, Zn, Mn and Cu content in comparison to untreated plants. This increase by using various combinations suggests synergistic interactions among compost and both humic and ascorbic acids.

The effect of compost application, humic acid and ascorbic acid as foliar spray individually or in combination on content of micronutrient for sesame seeds are presented in Table (9). Results revealed that significant increase in Fe, Zn, Mn and Cu content when plants treated with both humic and ascorbic acids lonely compared to applying compost alone or in combined with humic or ascorbic acid as foliar spray. The highest values of Fe, Zn, Mn and Cu contents were 459.66 50.46, 321.2 and 13.83 (g/fed), respectively which achieved by treating plants with ascorbic acid individually as foliar spray at rate of (1.5g/L). Concerning the effect of ascorbic acid, the results revealed that plants treated with ascorbic acid showed an increase in protein, oil yield, and P, K, Fe, Mn, Zn and Cu contents. In this connection ascorbic acid is currently considered to be as regulator for plant growth and development owing to their effects on cell division and differentiation. The obtained results revealed also that the effect of all treatments on seed quality and quantity parameters followed a similar trend to those of the nutritional status of seeds possibly due to high correlation between them. Regarding the effect of interaction, the highest values, of Fe , Zn, Mn and Cu content were 379.66 ,43.85, 243.31 and 9.72 (g/ha), respectively which achieved by combined treatment between compost and humic acid at rate (1.5g/L). Furthermore, application of humic acid increased the uptake of K, Mg, Na, Cu and Zn. However, humic acid did not only increased macronutrient contents, but also enhanced micronutrient contents of the plant organs.

Table 9: Micronutrients content for sesame seeds as affected by foliar spray with humic, ascorbic acids and compost application (mean values of two seasons 2012-2013).

Treatments	Fe (g/fed)	Zn (g/fed)	Mn (g/fed)	Cu (g/fed)
Control	189.33	19.19	115.32	4.32
Hu(1.5g/)	350.66	37.74	209.07	7.92
Hu (3g/L)	422.33	46.99	276.13	11.85
Mean	386.50	42.37	242.60	9.89
As (1.5g/L)	459.66	50.46	321.21	13.83
As (3g/L)	433.66	47.23	282.73	12.13
Com	446.66	48.85	301.97	12.98
Mean	255.66	28.97	169.98	6.59
Com+Hu(1.5g/)	379.66	43.85	243.31	9.72
Com.+Hu(3g/L)	285.33	29.98	190.53	7.33
Mean	332.50	36.92	216.92	8.53
Com.+As(1.5g/)	296.00	34.50	192.47	7.46
Com.+As(3g/L)	338.66	38.36	226.45	8.87
Mean	317.33	36.43	209.46	8.17
LSD $_{0.05}$	27.852	2.48.1	15.494	0.672

Hum: humic – Ascorbic acid: Asc – Com : compost

Humic acid plays a major role in plant nutrient uptake and growth parameter in plants in both vegetative and generative stage (Ulukan, 2008). It was found that, increasing compost addition rate increased N, P, K and Mn content in plant tissues, as well as soil Ec and pH (Gaber, 2000 and Rangarajan *et al*., 2000). The same results were reported by Karaca (2004), Weber *et al*., (2007) who indicated that Zn and Cu increased with increasing application rate of different compost materials. Composting can concentrate or dilute micronutrients and heavy metals (Zorbas *et al*., 2002). Hermann *et.al.* (2000) found that humic acid essentially helps the movement of micronutrient from soil to plant. The positive effect of humic acid and organic fertilizer on the yield capacity of soil consists of many components. Firstly, these components concern nutrient supply to plants. Secondly, physical soil properties are affected resulting in differences in root penetration, gas exchange and water supply.

CONCLUSION

It can be concluded that humic and ascorbic acids as alone or combined with compost enhanced growth parameters, i.e. germination %, shoot length, radical length, fresh weight of seedling, EC, carbohydrate %, No. of capsules, seed weight /plant (g), 1000-seed weight (g), seed yield (Kg/fed), plant height and fruiting zone length of sesame. Results also revealed that the applying ascorbic acid as foliar spray at rate (1.5g/L) alone gave the best values in sesame seeds quality i.e. protein, oil yield and P,K ,Fe, Zn, Mn and Cu content. While, in combination treatment the highest values achieved by using compost with humic acid at the rate (1.5g/L).

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دورحامضى الهيوميك والأسكوربيك فى وجود او عدم وجود الكمبوست فى تحسين محتوى العناصر و المحصول ومكوناته وجودة البذور فى السمسم

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أجريت تجربتان حقليتان بمحطة بحوث الإسماعيلية خلال موسمي 2013/2012 لدراسة تاثير استخدام مادة عضوية (كمبوست) والرش الورقي لكل من حامض الأسكوربيك وحامض الهيوميك وذلك بمعدلي إضافة (1,5 – 3,0 جرام/لتر) سواء بمفردهما أو عند ارتباطهما مع الكمبوست وتأثير ذلك على إنتاجية وجودة محصول السمسم صنف سوهاج 1 .

وفيما يلى اهم النتائج:

- أن الرش الورقي لكل من حمض الهيوميك والإسكوربيك بمعدلى (1,5 – 3,0 جرام/لتر) سواء بمفردهم أو عند ارتباطهم بالكمبوست أدى إلى زيادة معنوية لقوة البادرة والمتمثلة فى نسبة الإنبات, طول الريشة ,طول الجذر ، قوة البادرة, , طول النبات، ارتفاع المنطقة الثمرية، عدد الكبسولات، المحصول ومكوناته مقارنة بالنباتات الغير معاملة.
- اشارت النتائج الى زيادة فى نسبة كل من للبروتين، للزيت، للفسفور، للبوتاسيوم و الكربوهيدرات فى البذور وكذلك تركيزات العناصر الصغرى (حديد – زنك – منجنيز – نحاس).
- اظهرت النتائج أن استخدام حامض الاسكوربيك بمعدل 1,5جم/لتر وذلك بمفرده قد اعطى أعلى قيم لكل من محصول الزيت والبروتين ومحتوى البذور من الفوسفور والبوتاسيوم وكانت كالآتي: 233,61 - 635,09 - 5,72 - 43,4 كجم /فدان على التوالي.
- كما زاد محتوى العناصر الصغرى (حديد – زنك – منجنيز – نحاس) وقد كانت القيم كالآتي: 459,67 - 50,46 - 321,21 - 13,83 جم /فدان على التوالي.
- اوضحت النتائج ان معامل الأرتباط فقد أعطت المعاملة (كمبوست + 1,5 جرام/لتر حامض الهيوميك) أعلى قيم لكل من (محصول البروتين والزيت ومحتوى العناصر (فوسفور – بوتاسيوم) وكانت كالآتي : 161,46 – 473,97 – 3,98 - 31,8) كجم/فدان على التوالى أما بالنسبة لمحتوى العناصر الصغرى (حديد – زنك – منجنيز – نحاس) فقد كانت القيم كالآتي: 379.67 – 43,85 – 243,31 – 9,72) جم / فدان على التوالي.