Minufiya J. Agric. Res. Vol.40 No. 6: 1629 – 1645 (2015) **"http://www.mujar.net"**

FOLIAR APPLICATION OF ORGANIC ACIDS AND ANTIOXIDANTS IMPACT ON FRUIT YIELD AND QUALITY OF FIG AND OLIVE TREES IN SOME VALLEYS OF NORTHWESTERN COAST OF EGYPT

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(Received: Sep. 2 , 2015)

ABSTRACT: *Two field experiments carried out in two farms, located in the north western coast soils of Egypt. The first farm was olive trees in Sanab valley, while the other farm was fig trees in Hashem valley, which selected for its higher increase the homogeneity or symmetry between trees. The texture farm soils was sandy loam, the main source of irrigation water for the fig and olive trees is seasonal rain water. Some additions of irrigation water are depended on the quantity of store water in valley wells, the area of olive tree 8 years old was 100m^2 (100 trees/ha) while the fig tree 10 years old was 156m^2 (64 trees/ha). The aim of this research is to study the effect the foliar application of amino and humic acids and antioxidants on fruits of fig and olive trees under water drought conditions in North-Western Coast soils.*

Foliar application of amino acid (Am), humic acids and antioxidants as ascorbic acid (As) with mineral fertilization were applied. The yield components, total antioxidants, total phenols, total sugar %, oil content % and nutrients concentrations of fig and olive trees were increased with increasing rates of amino acid, humic acids and antioxidants. The beneficial effect of added treatments on yield components of fig and olive trees were arranged as follows; ascorbic acid (As) > amino acids (Am) > humic acid > control. The most effective treatment was Am_2AS_3 with humic$_2$ (ascorbic acid at 600 ppm) with amino and humic acids (at 400 ppm), which achieved 41.2Mg ha^{-1} of fig fruits (64 trees/ha) and 18.9 Mg ha^{-1} of olive fruits (100 trees/ha).The foliar antioxidants recorded higher increases of yield parameters fruits of fig and olive trees than amino acids and humic acid, while the humic acid showed the lowest effect. The effect trilateral interactions between studied factors (ascorbic acid, amino acids and humic acid) were higher for yield component, nutrients content, total phenols, total antioxidants in leaves and fruits of fig and olive trees than the bilateral and individual interactions, while the individual interactions appeared the lowest effect.

Key words: *Foliar amino and humic acids and antioxidants, fruits yield, fig and olive trees.*

INTRODUCTION

The irrigation water source for fig and olive trees in the North-Western Coast was the rains water which is starting from October or November until February and March every year. In some areas, possible use supplementary irrigation water system from wells water after the rainy season is ended. Therefore, these soils need for supplemental irrigation to complete plant growth and production.

Humic molecules increased leaf water retention and the photosynthetic and antioxidant metabolism under water stress. The humic substances increased the roots density and absorbed nutrients across the plasma membranes of roots. The humic acid increased morphological criteria (plant height, leaves number, fresh and dry weights of shoots), metabolism (photosynthetic pigment, total soluble sugar, total carbohydrates, total amino acids and proline), mineral contents (N, P, K, Ca and Mg) and yield (grain, straw and biology) of plants, Under salt stress, the foliar application of humic substances increased the uptake of nutrients by corn plant, the previous facts according to Fahramand *et al.* (2014), Canellas and Olivares (2014), El-Bassiouny *et al.* (2014) and Khaled and Fawy (2011), respectively.

Amino acids functions in plant such as protein synthesis, stress resistance, effect of photosynthesis, action on the stomas, chelating effect, activators of phytohormones, pollination with fruit formation and equilibrium of soil flora, above findings according to Ortiz-Lopez *et al.* (2000), Abd El-Samad *et al.* (2010) and Gioseffi *et al.* (2012).

Antioxidants defense machinery protects plants against oxidative stress damages by scavenging of reactive oxygen species (ROS). Antioxidant machinery, such as antioxidant enzymes, ascorbic acid, carotenoids and flavonoids, the antioxidant enzyme activity protect plant cells from light, temperature and drought stress. Antioxidant as flavonoids contribute greatly to ROS-detoxification through chemical reactive for oxygen species (ROS) in plant and human cells, flavonoids have the greatly potential to effect on mitogen-activated protein kinases (MAPK) process to form protein in plants, the previous findings according to Hamid *et al.* (2010), Gill and Tuteja (2010), Agatia *et al.* (2012), and Brunetti *et al.* (2013).

Effect of foliar organic acid and antioxidants applied on yield parameters and nutrients contents of fig an olive trees ; Yousef *et al.* (2011) reported that spray 0.5% of (Humic acid +amino acids + potassium dihydrogen phosphate + chelated form of Zn, Mn and Fe) was most effective for growth and yield components of olive trees. Hagagg *et al.* (2010) stated that yield components of olive trees improved by humic acid application. Yousef *et al.* (2011) reported that foliar spray amino acids at 0.5% alone or in combination with mixture of micro elements (Zn + Mn + Fe) at 0.25 was most effective for yield components of olive trees (Yousef *et al.,* 2011). Hagagg *et al.* (2013) stated that foliar 75 ml\tree of humic acid 20% and 50 ml\tree of amino acid 20% at full bloom stage and after one month from full bloom stage achieved highest yield components and oil content of fruits olive trees. Shalaby and El-Ramady (2014) reported that foliar amino acids at (1.2 ml/L), yeast (2 g/L) and ascorbic acid (0.2 g/L) increased yield components of garlic plant. Mujić *et al.* (2012) stated that total phenols content in fruit figs extract by 70% methanol ranged from 7.24 to 11.17 mg CAE/g of dry extract. Maksoud *et al.* (2009) reported that the foliar ascorbic acid or citric acid at 2000 ppm alone or with bio-fertilizer improved yield, fruit quality, oil and antioxidants contents in olive trees. Sulaiman and Hassan (2011) reported that the total sugar in fig fruits ranged from 20 to 31 g/100gFW, while the nutrients content in fruits were 572, 222, 152, 5.3, 0.38, 8.6, 44.7 and 7.5 mg/100g FW for K, Ca, P, Fe, Cu, Zn, Mg and Na respectively. El-Sayed *et al.* (2014) stated that ascorbic acid applied at 3000 ppm to olive trees improved yield parameters when comparison with rate(2000 ppm). on the other side, Azad *et al.* (2014) reported that foliar ascorbic acid at 500ppm with 60mg/L of humic acid were most efficient treatment to achieve highest yield components of olive trees.

Concerning the effect of mineral fertilizers on fruit olive and fig trees production, Mimoun *et al.* (2004) reported that foliar K for olive trees increased fruit weight, pit ratio, polyphenol and others mineral elements. Barranco *et al.* (2010) stated that the foliar mono-potassium phosphate (MKP) 3% plus urea was the most effective treatment for yield and oil content of fruits of olive. Hagagg *et al.* (2012) stated that the foliar 50g of ($20N/20P_2O_5/20K_2O$) at form (37.5 g in soil + 12.5 g foliar application) improved height increment, leaves number, enhanced leaf dry weight and root length, while highest number and weight of olive fruits achieved with (12.5g in soil + 37.5g as foliar application). Malek and Sanaa (2013) reported that the yield components of olive fruits increased with increasing rates of NPK fertilizer. Aydin *et al.* (2001) reported that foliar Zn (0.15%) in three times gave maximum yield components of fig fruits. Jagtap *et al.* (2012) stated that the foliar $FeSO_4$, $ZnSO_4$ and boric acid increased yield parameters of fig fruits and micronutrients contents of fig trees. Abbasi *et al.* (2012) stated that the macro (20 N, 10 P and 20% K) and micro (157B, 225 Fe, 112Zn, 120Mn, 52Cu, 7Mo and 6 Co mg/L) combination with emulsifier achieved highest yield parameters of olive fruits. Ercisli *et al.* (2012) reported that the total phenols ranged from 24 to 237 mg of gallic acid equivalent per 100 g fresh weight, while the total antioxidant ranged 4.6 to 18.7 mmol Fe_2/kg FW of fig fruits. Tekaya *et al.* (2013) reported that the foliar macro-micronutrients improved yield parameters of olive trees, nutrients uptake and oil stability and increased with increasing the content of antioxidants.

The objective of this research were to determine the influence of foliar application macro and micronutrients with amino, humic and ascorbic acids on fruits yield and quality, nutrients content, total antioxidants, total phenols, total sugar %, and oil content % of fig and olive trees. Determine the ability of the tested trees to resistance the salinity and drought conditions of the North West Coast soils - Matrouh Governorate of the North West Coast soils - Matrouh Governorate.

MATERIALS AND METHODS

Two experiments carried out in two farms, the olive farm was in Sanab Valley located at 31º 2.84' 21'' N and 27º 58.03' 05'' E, while fig trees farm was the second in Hashem valley located at 31º 44.19' 08'' N and 27º 10.32' 38'' E, which selected for the higher homogeneity or symmetry between trees. The texture farm soils was sandy loam, the main source of irrigation water for the fig and olives trees is the seasonal rain water. Some additions of irrigation water were depended on the valley contain from the water stored in wells. The area of olive tree (8 years old) was 100m^2 (10x10),100 trees/ha while area of the fig tree 10 years old was 156 m^2 (12x13), 64 trees/ha. The foliar applied of ascorbic, amino and humic acids on fruits of figs and olives under water drought conditions in north-western coast soils were investigated. Analytical data of the studied soils are presented in Table (1). Analyses were accomplished according to Page *et al.* (1984) and Klute (1986).

The rainy season starts in November and remains in December, January and part of February. AL mostly at the rainy season, a plenty of soil nutrients content would be dissolved in the rain water, consequently, it will be taken up by tested trees, particularly available nitrogen. Those trees store these nutrients in their branches. Where in this time, trees not start to make new shoots under conditions of cold weather, especially in the month of December and January, when the temperature start to increase and the weather begins to warm, the buds release to form new leaves and begin the vegetative growth stage.

The requirements of nutrients for fig trees during the stages growth were different about the olive trees requirements. Foliar applied amount of mineral fertilizers to the fig and olive farms were applied at one rate (control) through the two seasons is described at Table (2). The foliar mineral fertilizers, amino acids 20% (2.9% Fe, 1.4% Zn and 0.7% Mn), K-humate (86% humic acid and 12% K_2O) and ascorbic acid (100%) application regime as following; during March and April, the vegetative growth stage and the formation of the new leaves, the foliar A was adding. After the end of the flowering stage and the beginning of the fruit composition stage during the month of May and July, the foliar B was added. During the June and August the foliar C was added. The foliar rates of humic acid were 200 and 400 ppm equal 4.66 and 9.32 g of K-humate/20L, respectively, while the amino acids rates were 200 and 400 ppm equal 20 and 40 ml of amino acids/20L, respectively. The antioxidants (ascorbic acid) were 200, 400 and 600 ppm equal 4, 8 and 12 g of ascorbic acid (100%)/20L, respectively.

The harvest stage of olive trees is in the September and October months, while the harvest stage of figs trees is two crops yield, the first crop at the end of June month and the second crop in the September month. Plant samples were collected at harvesting stage in the end of each experiment. The number branches/tree, number fruits/branch, number fruits/tree, weight one fruit(gm), weight fruits (kg/tree) and weight fruits (ton/tree) of the figs and olives trees recorded during the studied two seasons. Plant samples were analyzed for N, P and K according to Cottenie *et al.* (1982). The official Lane-Eynon method described in AOAC was used to measure the total sugar (TS %) in fruit (James, 2004 and Horowitz, 2000), while the oil was extracted from the olive fruits samples using chloroform: methanol mixture (2:1, V/V) and SOXHLET extraction method according to Kates (1972) and Petrakis (2006). Measurements of total antioxidants and total phenolic acids in both soils and plants were done according to Rimmer (2009).

Table (1). Some of chemical and physical soil properties of the studied soils.

Depth Cm	soil paste extract pH	soil paste extract EC dS/m	OM %	$CaCO_3$	Particle size distributes Sand	Silt	Clay	CEC $emol_c\ kg^{-1}$	Texture
Sanab Valley (Olive farm)									
0 – 30	7.71	1.80	1.14	15.34	64.11	21.18	14.71	15.35	S.L
30 -60	8.03	1.88	0.56	15.97	62.64	20.21	17.15	16.22	S.L
Hashem Valley (Fig farm)									
0 – 30	8.16	1.70	1.25	16.41	61.61	21.73	16.66	16.71	S.L
30 -60	8.44	1.79	0.68	18.01	57.87	22.18	19.95	18.58	S.L

Soluble cations and anions in soil ($mmol_c\ L^{-1}$) and Total antioxidants and phenol acids in soil

	Na	K	Ca	Mg	HCO_3^-	Cl^-	SO_4^{2-}	T. phenol	T.A.A
Sanab Valley (Olive farm)									
0-30	7.53	0.25	5.80	4.50	0.70	12.00	5.38	643	182
30-60	8.46	0.27	5.70	4.80	0.75	12.50	5.98	316	93
Hashem Valley (Fig farm)									
0-30	5.87	0.65	5.80	4.60	0.60	11.50	4.82	705	199
30-60	6.10	0.70	6.00	5.00	0.60	12.00	5.20	384	108

Available nutrients in soil (mg kg^{-1})

	N	P	K	Fe	Mn	Zn	B	Cu
Sanab Valley (Olive farm)								
0-30	42.6	1.72	134	11.8	8.12	5.19	4.73	0.71
30-60	18.8	1.38	158	14.5	9.43	6.24	5.11	0.87
Hashem Valley (Fig farm)								
0-30	48.2	1.86	161	13.5	9.14	6.18	5.65	0.82
30-60	23.7	1.53	182	15.7	10.93	7.86	6.24	0.96

Nutrients status of leaves and biochemical contents before applied any fertilizers

Farms	N	P	K	Fe	Mn	Zn	B	Cu	T. ph.	T.A.A
	%			Mg kg^{-1}					μg ml^{-1}	
Olive	0.73	0.09	0.56	53.3	41.1	23.8	18.6	1.58	544	271
Fig	0.94	0.07	0.74	44.4	56.8	17.5	12.4	1.85	361	181

S.L= Sandy Loam soil, T.ph = Total phenols (μmol of Gallic acid/ml extract),
T.A.A= Total antioxidants activity (μg of Ascorbic acid/ml extract).

Table (2). Treatments of amino, humic and ascorbic acids and mineral fertilizers for fig and olive trees.

Foliar Treatments	Fig tree			Olive tree		
	N	P	K	N	P	K
One rate of mineral fertilizer applied for all treatments at three sequence doses (mg kg^{-1}) at 600L						
Foliar A	1017	290	799	846	435	625
Foliar B	846	377	972	675	580	799
Foliar C	675	435	1215	508	652	1007
Micronutrients treatment (mg kg^{-1})						
Micro	300 ppm of Fe, Mn and Zn while 50 ppm of B (as Boric acid)					
Organic acid and antioxidant rates						
Humic acid	200 and 400 mg kg^{-1} (4.66 and 9.32 g of K-humate 86%/20L respectively)					
Amino acids	200 and 400 mg kg^{-1} (20 and 40 ml of amino acids 20%/20L respectively)					
Ascorbic acid	200, 400 and 600 mg kg^{-1} (4, 8 and 12 g of ascorbic acid 100%/20L respectively)					

Soil and plant Phenolic Acids and Total antioxidant

Two grams of soil was extracted with 10 mL of deionized (DI) water and shaking for 16 h on a reciprocal shaker followed by centrifugation and collected the supernatant for purification. The soil pellet was then extracted with 10 mL of 50 mM EDTA (pH 7.5) for 16 h on a reciprocal shaker. After EDTA extraction, the samples were centrifuged and the supernatant saved for purification. Rimmer (2009).

Antioxidant ability assays Total antioxidant activity

The extract (0.1 ml) was mixed with 3 ml of reagent solution (0.6 M sulphuric acid, 28 mM sodium phosphate and 4 mM ammonium molybdate). The tubes were incubated at 95°C for 90 min. The mixture was cooled to room temperature, and then the absorbance of the solution was measured at 695 nm against blank. The total antioxidant activity was expressed as ascorbic acid equivalents in milligrams per gram of the extract (Prieto *et al.,* 1999).

Measurement of total phenol compounds

Total phenolic constituents of plant extracts were performed employing the literature methods involving Folin-Ciocalteu reagent and gallic acid as standard (Slinkard and Singleton, 1977). Extract solution (0.1 ml) containing 1000 ug extract was taken in a volumetric flask, 46 ml distilled water and 1 ml Folin-Ciocalteu reagent were added and flask was shaken thoroughly. After 3 min, 3 ml of solution 2% Na_2CO_3 was added and the mixture was allowed to stand for 2 h with intermittent shaking. Absorbance was measured at 760 nm. The same procedure was repeated to all standard gallic acid solutions (0-1000 mg, 0.1 ml-1) and standard curve was obtained. In two successive years with two field experiments, statistical analysis was carried out using spilt-split technique in randomize complete blocks design with three replications for each treatment. The obtained data were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of organic acids and antioxidants on fruits yield of fig and olive trees.

The nutrition status of fig and olive leaves grown in Hashem and Sanab valleys before applied any amendments and fertilization, besides the available nutrients in the two farms are present at (Table 1). Some of available nutrients were not sufficient for growth requirements of fig and olive trees. Therefore, a foliar application of mineral fertilization and some amendments to complete the plant growth and production especially when rain season end become necessary and it must be taken in the consideration.

The NPK and micronutrients fertilizers applied at one rate for all studied treatments (Table 2) which were suitable nutrients to approach the sufficient levels of nutrients for obtain a good growth and highest fruits production of fig and olive trees.

Data in Table (3) and Fig (1) showed that the yield components of fig and olive trees increased with increasing the applied rates of foliar humic, amino and ascorbic acids. In this respect, the antioxidant (ascorbic acid) treatment induced the higher yield of fig and olive fruits than the amino acid, while the humic acid occurred the lowest effect. Ascorbic acid treatment recorded increases over control treatment by 29.1, 20.2 and 25.6% for number branches, number fruits and weight fruits of figs trees respectively while the amino acids treatment achieved 21.5, 14.1 and 20.2%, and the humic acid 7.1, 5.7 and 15.3% in comparison with the control.

The interactions between the amino acids and humic acid increased impact on the yield parameters of fig and olive fruits by increasing organic acids rates. The treatment (200mg/kg of amino acid + 400 mg/kg of humic acid) induced a higher increases of fruits yield than control treatment amino acid + 400 mg/kg of humic acid by 9.0, 3.4 and 5.7% for number of branches, number of fruits and weight of fruits/fig tree, respectively, while 400 mg/kg of amino acid achieved 11.9, 7.3 and 10.2% more than others. On the other side, the same trend occurred with olive trees, the treatment (400 mg/kg of amino acid + 400 mg/kg of humic acid) showed a higher increases for fruits yield than control treatment of amino acid with 400 mg/kg of humic acid by 4.6, 2.1 and 5.7% for number branches, number fruits and weight one fruit/figs tree, respectively.

The interactions between amino, humic and ascorbic acids achieved the highest increases for fruits yield components of fig and olive when compared with other studied treatments. The most affect treatment ($Amino_2$ $Ascorbic_3$ $Humic_2$) achieved 41.2 $Mgha^{-1}$(64 fig trees/ha) and 18.9 $Mgha^{-1}$ (100olive trees/ha). Under the superior treatment conditions (Am_2AS_3 $Humic_2$), antioxidant recorded higher increases of fruits yield of fig trees above control treatment about 25.0, 15.4 and 20.5%, while the amino acids recorded about 18.1, 9.1 and 12.8%, and the humic acid insulted about 9.9, 2.8 and 12.8% for number branches, number fruits and weight fruits (gm) respectively. The same trend was observed on olive trees (Table 3).

The previous results indicate that the antioxidants were the most beneficial effective on the trees fruits production of fig and olive trees. Followed by amino acids and humic acid, this due to the antioxidants have an important role to increase the ability of olive and fig trees to resistance drought conditions and increase of proline levels in the plant, which increase the plant ability to continue the natural growth under conditions of Matarouh valleys, These facts has been reported by Fahramand *et al.* (2014), Canellas and Olivares (2014), El-Bassiouny *et al.* (2014) and Khaled and Fawy (2011). The importance of the role of humic and amino acids in the plant stated by Ortiz-Lopez *et al.* (2000), Abd El-Samad *et al.* (2010) and Gioseffi *et al.* (2012), while the plant's ability to tolerate drought stress conditions and role of antioxidants decided by Maksoud, *et al.*(2009), Hamid *et al.*(2010), Gill and Tuteja (2010), Agatia *et al.* (2012), and Brunetti *et al.* (2013). The above results agree with those obtained by Mujić *et al.* (2012), El-Sayed *et al.* (2014) and Azad *et al.* (2014).

Table (3). Effect of foliar amino, humic and ascorbic acids applied on the yield components of fig and olive trees (average of the two seasons).

Treatments		No. Fruits /branch	No. Fruits /tree	W. one Fruit (g)	W. Fruits Mg/ha	No. Fruits /branch	No. Fruits /tree	W. one Fruit (g)	W. Fruits Mg/ha
		Fig trees (64 trees/ha)				Olive trees (100 trees/ha)			
Humic $acid_1$	Control	75	4125	48.5	12.8	12.9	12690	5.27	6.7
	Am_0AS_1	77	4543	49.7	14.5	14.5	13328	5.53	7.4
	Am_0AS_2	83	5395	54.5	18.8	18.9	15686	5.93	9.3
	Am_0AS_3	87	6177	59.7	23.6	23.7	18023	6.49	11.7
	Am_1AS_0	78	4836	51.5	15.9	16.0	13737	5.63	7.7
	Am_1AS_1	81	5508	55.6	19.6	19.7	14945	5.85	8.7
	Am_1AS_2	85	6290	60.8	24.5	24.6	16770	6.25	10.5
	Am_1AS_3	89	6942	64.5	28.7	28.8	18837	6.89	13.0
	Am_2AS_0	80	5200	53.2	17.7	17.8	14337	5.78	8.3
	Am_2AS_1	85	5950	57.2	21.8	21.9	16064	6.32	10.1
	Am_2AS_2	89	6675	62.4	26.7	26.8	17884	6.81	12.2
	Am_2AS_3	93	7347	66.6	31.3	31.4	20294	7.38	15.0
Humic $acid_2$	Control	79	4819	56.4	17.4	17.5	14520	6.57	9.5
	Am_0AS_1	81	5265	61.1	20.6	20.7	15435	6.34	9.8
	Am_0AS_2	87	6177	66.7	26.4	26.5	18216	6.86	12.5
	Am_0AS_3	94	7238	69.8	32.3	32.5	20625	7.39	15.2
	Am_1AS_0	83	5561	62.3	22.2	22.3	15808	6.54	10.3
	Am_1AS_1	85	6290	64.6	26.0	26.1	16566	6.95	11.5
	Am_1AS_2	89	6853	69.3	30.4	30.5	19368	7.46	14.4
	Am_1AS_3	96	7968	73.2	37.3	37.5	21918	7.84	17.2
	Am_2AS_0	85	5865	65.5	24.6	24.7	16683	6.69	11.2
	Am_2AS_1	89	6675	68.4	29.2	29.3	17990	7.36	13.2
	Am_2AS_2	95	7695	73.4	36.1	36.3	20748	7.83	16.2
	Am_2AS_3	99	8514	75.4	41.1	41.2	22880	8.26	18.9
$LSD_{0.05}$ Humic		1.43	106	2.91	2.09	2.09	2.09	0.29	0.95
$LSD_{0.05}$ Amino		0.32	50	0.34	0.38	0.38	0.38	0.04	0.14
$LSD_{0.05}$ Ascorbic		0.26	80	0.24	0.29	0.29	0.29	0.03	0.12
$LSD_{0.05}$ Hu x Am		0.31	70	0.49	0.55	0.55	0.55	0.04	0.19
$LSD_{0.05}$ Hu x AS		0.37	113	0.34	0.40	0.40	0.40	0.04	0.17
$LSD_{0.05}$ Am x AS		0.45	139	0.42	0.48	0.48	0.48	0.05	1.13
$LSD_{0.05}$ 3 factors		0.64	196	0.59	0.69	0.69	0.69	0.06	1.64

No =number, Am=amino acids, AS= ascorbic acid, Mg/ha= 10^9 g/hectare ($10000m^2$).

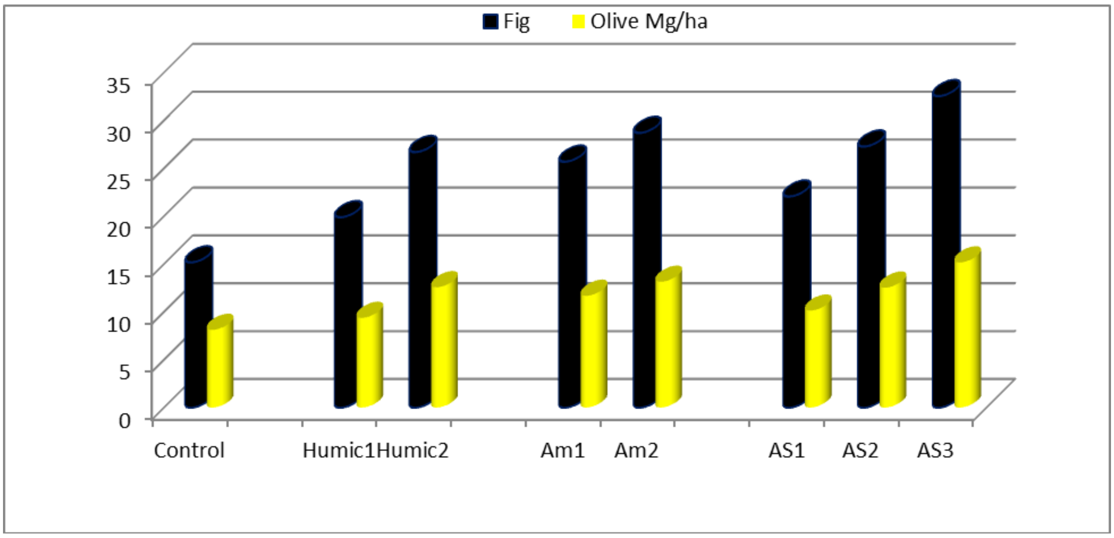

Fig. (1): Effect of foliar humic acid (humic), Amino acid (Am) and ascorbic acid (AS) ascorbic acid on fruits yield (Mg/ha) of fig and olive trees.

Effect of studied treatments on nutrients contents in fig and olive trees:

The nutrients contents in leaves and fruits of fig and olive trees increased with increasing the organic acids and antioxidant rates. The superior treatment (Am_2AS_3 Hu_2) achieved highest nutrients contents in leaves and fruits of both figs and olive trees when compared with other studied treatments.

Data at Table (4) and Figs (2 to 5) show that antioxidants treatments showed the highest effect on P and micronutrients contents. Amino acids achieved the highest effect on N contents, while humic acid was the highest for K contents in leaves and fruits of both fig and olive trees. The ascorbic acid increased N, P, K, Fe, Mn, Zn, B and Cu by 27.6, 15.7, 36.4, 10.4, 9.5, 22.7, 51.2 and 30.5% in fig leaves respectively, over control treatment, while that they were 28.4, 24.1, 20.6, 21, 20.4, 34, 49.6 and 37.7% for figs fruits. The amino acid treatment recorded about 35.3, 17.3, 37.6, 9.6, 9.4, 22.5, 49.4 and 29.7% for N, P, K, Fe, Mn, Zn, B and Cu of fig leaves compared to control respectively. While that they were 37.4, 22.5, 21.3, 20.1, 20.5, 33.9, 46.4 and 36.9 % for fig fruits. The humic acid achieved increase over control treatment by about 29.7, 14, 41.8, 9.6, 8.3, 19.9, 43.1 and 25.8% for N, P, K, Fe, Mn, Zn, B and Cu of figs leaves respectively, while that they were 27.6, 19.7, 26, 18.1, 16.9, 30.6, 41.8 and 34.3% for fruits of fig trees at (Table 4 and 5). The previous results agree with that obtained by Yousef *et al.* (2011) Hagagg *et al.* (2012) and El-Sayed *et al.* (2014).

Data in Table (5) showed that the same trend of nutrients behavior in fig trees was occurred in olive trees, where the foliar application of ascorbic acid (antioxidants) increased nutrients concentrations of leaves and fruits of olive trees over control treatment by 20.3, 22.6, 29.2, 10.4, 19, 24.5, 45.5 and 46.9% for N, P, K, Fe, Mn, Zn, B and Cu of olive leaves respectively. While that they were 23.4, 27.6, 24.3, 11.1, 14.6, 25.7, 44.6 and 43.7% for olive fruits. The amino acid recorded increases of nutrients above control treatment by about 27, 20, 31.9, 9.8, 17.3, 22.9, 41.2 and 44.5% for N, P, K, Fe, Mn, Zn, B and Cu of olive leaves respectively, while that they were 29.2, 23.9, 25.7, 9.9, 13.7, 24.9, 40.7 and 41.1% for olive fruits. The humic acid achieved increases of nutrients over control treatment by about 19, 18.7, 33.3, 7.8, 15.8, 20.6, 38.6 and 40.8% for N, P, K, Fe, Mn, Zn, B and Cu of olive leaves respectively, while that they were 22.4, 23.6, 30.5, 9.4, 11.9, 21.6, 36.3 and 35.8% for olive fruits.

Table (4). Effect of foliar amino, humic and ascorbic acids applications on nutrients contents in leaves and fruits of figs trees in Hashem valley (average of the two seasons).

Treatments		Nutrients content in leaves of fig trees								Nutrients content in fruits of fig trees							
		N	P	K	Fe	Mn	Zn	B	Cu	N	P	K	Fe	Mn	Zn	B	Cu
		g/kg			mg/kg					g/kg			mg/kg				
Humic acid$_1$	Control	15.2	3.5	9.5	225	237	109	20	7.1	11.2	3.1	13.6	111	116	54	10	3.5
	Am_0AS_1	15.5	3.6	11.4	231	243	115	25	7.8	11.7	3.5	13.9	115	120	58	14	4.1
	Am_0AS_2	15.8	3.8	11.6	237	249	122	31	8.8	12	3.7	14.3	123	127	65	16	4.6
	Am_0AS_3	16.2	3.9	11.9	242	255	129	36	9.5	12.3	3.9	14.6	129	134	70	18	4.9
	Am_1AS_0	19.1	3.7	12.3	228	241	117	26	7.4	14.6	3.2	14.4	119	123	60	11	3.8
	Am_1AS_1	19.5	3.8	12.7	235	247	128	33	8.5	15	3.6	14.8	128	133	69	15	4.4
	Am_1AS_2	19.8	4	12.9	238	252	133	38	9.3	15.3	3.8	15.2	135	139	75	17	4.9
	Am_1AS_3	20.2	4.1	13.1	246	257	139	41	9.6	15.7	4	15.6	142	145	80	19	5.2
	Am_2AS_0	22.2	3.8	12.5	233	246	121	28	7.8	17	3.3	14.8	123	128	64	12	4.1
	Am_2AS_1	22.5	4	12.8	239	252	132	35	9.1	17.3	3.7	15.2	129	137	74	16	4.9
	Am_2AS_2	22.8	4.1	13.2	243	259	138	39	9.7	17.5	3.9	15.5	135	146	78	18	5.2
	Am_2AS_3	23.2	4.2	13.6	248	263	143	43	10.2	18	4.1	15.8	142	151	84	20	5.5
Humic acid$_2$	Control	18.3	3.7	13.4	235	242	118	25	7.8	11.9	3.3	17	121	125	62	12	4.1
	Am_0AS_1	18.5	3.8	15.4	242	248	126	29	8.5	12.2	3.7	17.5	128	131	69	15	4.7
	Am_0AS_2	18.8	3.9	15.8	249	255	133	34	9.3	12.6	3.9	17.8	133	136	74	17	5.5
	Am_0AS_3	19.2	4	16.2	255	262	139	39	10.2	12.9	4	18.2	139	142	80	19	5.9
	Am_1AS_0	21.6	3.9	15.8	239	251	127	27	8.1	15.3	3.4	17.9	127	129	69	13	4.3
	Am_1AS_1	21.9	4	16.4	245	257	133	33	9.2	15.8	3.8	18.4	132	137	75	16	5.1
	Am_1AS_2	22.3	4.1	16.7	253	263	140	38	9.9	16.2	3.9	18.6	138	144	82	18	5.5
	Am_1AS_3	22.6	4.2	17	256	266	146	42	10.6	16.4	4.2	19.1	143	149	87	21	5.8
	Am_2AS_0	23.5	4	16.3	242	255	131	29	8.6	17.4	3.5	18.4	131	133	74	14	4.6
	Am_2AS_1	23.8	4.2	16.7	249	261	137	36	9.8	17.9	3.9	18.7	137	141	79	17	5.4
	Am_2AS_2	24.2	4.4	17.3	255	265	144	39	10.6	18.2	4.1	19.1	143	148	85	19	5.9
	Am_2AS_3	24.5	4.5	17.8	259	269	150	45	11.2	18.5	4.3	19.4	148	153	90	22	6.4
$LSD_{0.05}$ Humic		0.65	0.05	1.13	3.20	2.22	2.34	0.50	0.21	0.18	0.05	1.01	2.12	1.65	1.27	0.41	0.19
$LSD_{0.05}$ Amino		0.3	0.02	0.1	0.32	0.49	0.66	0.35	0.05	0.27	0.01	0.06	0.58	0.67	0.60	0.10	0.03
$LSD_{0.05}$Ascorbic		0.02	0.01	0.04	0.34	0.33	0.40	0.29	0.05	0.02	0.02	0.02	0.36	0.39	0.35	0.15	0.03
$LSD_{0.05}$HuxAm		0.43	0.03	0.14	0.45	0.69	0.93	0.50	0.07	0.27	0.01	0.06	0.82	0.94	0.84	0.15	0.04
$LSD_{0.05}$Hux AS		0.03	0.01	0.05	0.48	0.35	0.56	0.42	0.07	0.03	0.02	0.03	0.51	0.56	0.50	0.21	0.04
$LSD_{0.05}$AmxAS		0.03	0.01	0.06	0.59	0.57	0.69	0.51	0.08	0.04	0.03	0.04	0.63	0.68	0.61	0.26	0.05
$LSD_{0.05}$3factors		0.05	0.02	0.06	0.83	0.80	0.98	0.72	0.12	0.05	0.04	0.05	0.89	0.96	0.86	0.37	0.08

Hu=Humic acid, Am=amino acids, AS= ascorbic acid

Table (5). Effect of foliar amino, humic and ascorbic acids applications on nutrients contents in leaves and fruits of olive trees in Sanab valley (average of the two seasons).

Treatments		Nutrients contents in leaves of olives trees								Nutrients contents in fruits of olives trees							
		N	P	K	Fe	Mn	Zn	B	Cu	N	P	K	Fe	Mn	Zn	B	Cu
		g/kg				mg/kg				g/kg				mg/kg			
Humic acid$_1$	Control	14.3	4	8.7	178	112	82	15	2.7	1.15	0.45	1.02	212	137	98	18	3.2
	Am_0AS_1	14.5	4.3	9.1	185	117	88	18	3.3	11.8	4.9	10.4	219	143	105	23	3.9
	Am_0AS_2	14.8	4.6	9.6	189	122	95	22	3.9	12.3	5.4	10.8	226	149	113	27	4.6
	Am_0AS_3	15.1	4.9	9.9	195	129	102	25	4.6	12.6	5.8	11.2	231	155	120	31	5.2
	Am_1AS_0	16.5	4.2	9.7	180	115	85	17	3.1	13.7	4.7	10.7	215	141	108	20	3.6
	Am_1AS_1	16.9	4.4	10.2	187	121	92	20	3.6	14.1	5.0	11.1	222	146	120	25	4.3
	Am_1AS_2	17.3	4.7	10.5	192	128	98	23	4.2	14.4	5.5	11.4	229	153	126	28	4.9
	Am_1AS_3	17.9	5	10.9	195	135	105	26	4.8	14.7	5.9	11.7	235	157	133	32	5.6
	Am_2AS_0	18.5	4.3	10.7	183	117	89	18	3.3	15.4	4.9	11.0	219	145	110	22	3.9
	Am_2AS_1	18.7	4.5	11.1	188	125	96	21	3.8	15.9	5.1	11.3	226	151	122	27	4.8
	Am_2AS_2	19.3	4.8	11.5	195	132	102	24	4.5	16.3	5.7	11.9	233	157	128	29	5.3
	Am_2AS_3	19.6	5.1	11.9	199	139	108	27	5.1	16.7	6.1	12.3	238	161	134	33	5.8
Humic acid$_2$	Control	14.8	4.3	11.4	179	119	88	17	3.2	12.1	5.0	13.0	220	143	107	20	3.6
	Am_0AS_1	15.1	4.6	11.9	186	126	96	21	3.9	12.7	5.5	13.6	227	149	115	25	4.3
	Am_0AS_2	15.6	4.9	12.5	191	131	103	25	4.5	13.0	5.9	14.0	234	154	123	29	4.9
	Am_0AS_3	16.1	5.2	13	198	139	109	28	4.9	13.2	6.4	14.4	239	159	128	32	5.5
	Am_1AS_0	17.1	4.4	12.6	183	123	91	19	3.5	14.5	5.2	14.2	224	146	115	22	3.9
	Am_1AS_1	17.5	4.7	12.8	189	129	99	23	4.3	14.7	5.6	14.6	229	153	121	27	4.6
	Am_1AS_2	17.9	5.1	13.1	194	135	106	26	4.8	15.9	6.1	14.9	238	158	128	30	5.4
	Am_1AS_3	18.4	5.3	13.6	199	143	112	29	5.3	16.3	6.5	15.2	245	163	136	33	5.9
	Am_2AS_0	18.9	4.6	13.1	189	126	95	20	3.7	16.5	5.4	14.6	228	149	120	23	4.2
	Am_2AS_1	19.5	4.9	13.6	195	133	105	24	4.7	15.8	5.8	15.2	234	155	125	28	4.9
	Am_2AS_2	19.9	5.2	14	201	139	111	27	5.3	16.2	6.2	15.7	238	162	134	31	5.7
	Am_2AS_3	20.6	5.5	14.5	206	145	116	30	5.8	16.6	6.6	16.0	243	167	140	34	6.1
$LSD_{0.05}$ Humic		0.19	0.09	0.77	1.03	2.29	2.12	0.79	0.17	0.2	0.2	1.0	2.24	1.50	1.79	0.45	0.09
$LSD_{0.05}$ Amino		0.21	0.01	0.09	0.35	0.37	0.36	0.12	0.03	0.2	0.0	0.1	0.31	0.35	0.67	0.13	0.03
$LSD_{0.05}$Ascorbic		0.03	0.02	0.02	0.32	0.38	0.39	0.19	0.04	0.0	0.0	0.0	0.37	0.33	0.43	0.22	0.04
$LSD_{0.05}$HuxAm		0.2	0.02	0.12	0.50	0.53	0.51	0.12	0.05	0.3	0.0	0.1	0.44	0.50	0.95	0.19	0.05
$LSD_{0.05}$Hux AS		0.04	0.02	0.04	0.46	0.40	0.56	0.27	0.05	0.0	0.0	0.0	0.53	0.35	0.61	0.32	0.05
$LSD_{0.05}$AmxAS		0.04	0.03	0.04	0.56	0.66	0.68	0.33	0.06	0.0	0.0	0.0	0.64	0.57	0.75	0.39	0.07
$LSD_{0.05}$3factors		0.06	0.04	0.06	0.79	0.93	0.72	0.35	0.09	0.1	0.1	0.1	0.91	0.81	1.06	0.41	0.09

Hu=Humic acid, Am=amino acids, AS= ascorbic acid

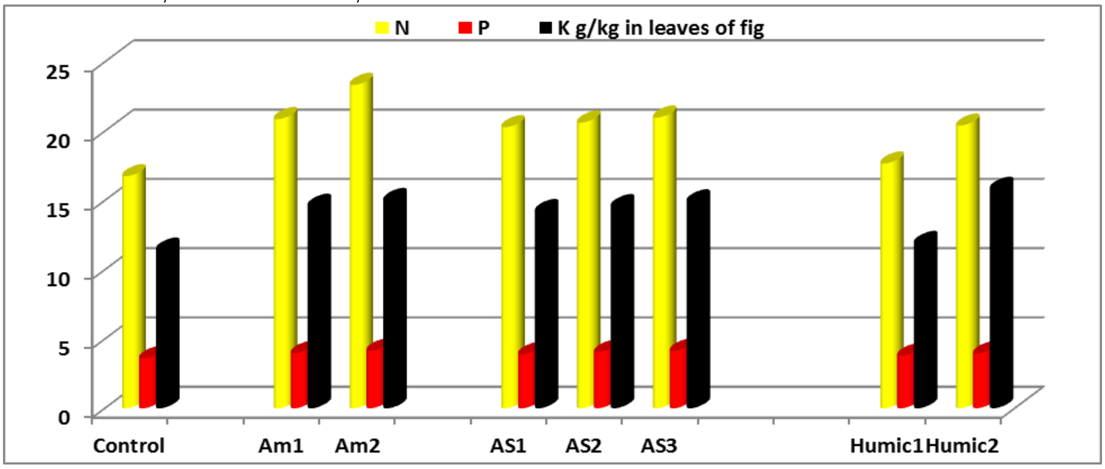

Fig. (2): Effect of organic acids and antioxidants on NPK of fig leaves

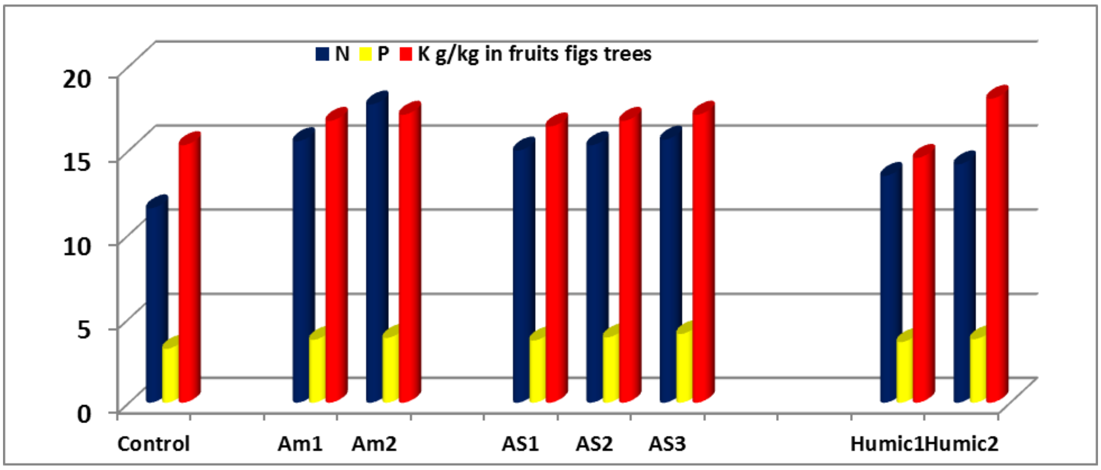

Fig. (3): Effect of organic acids and antioxidants on NPK of fruits fig.

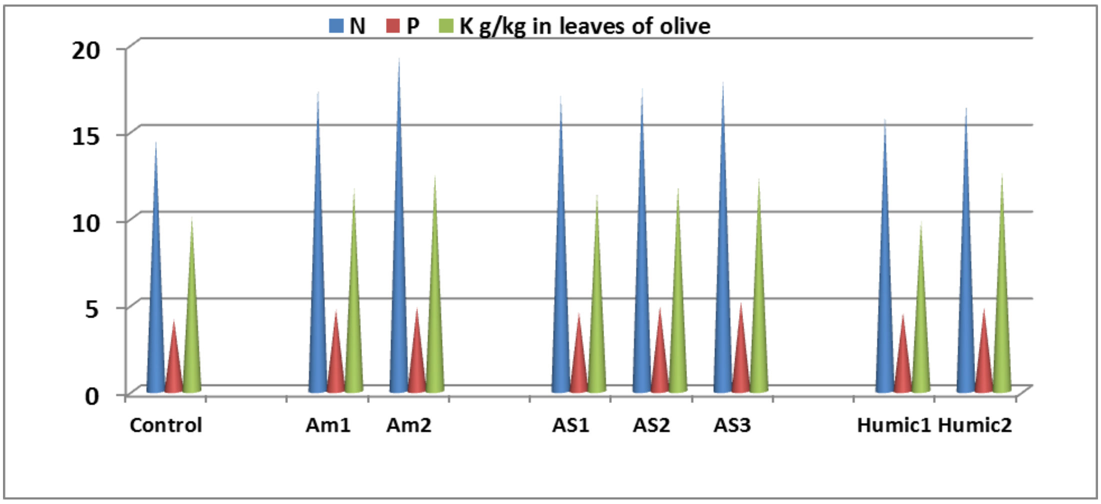

Fig. (4): Effect of organic acids and antioxidants on NPK of olive leaves

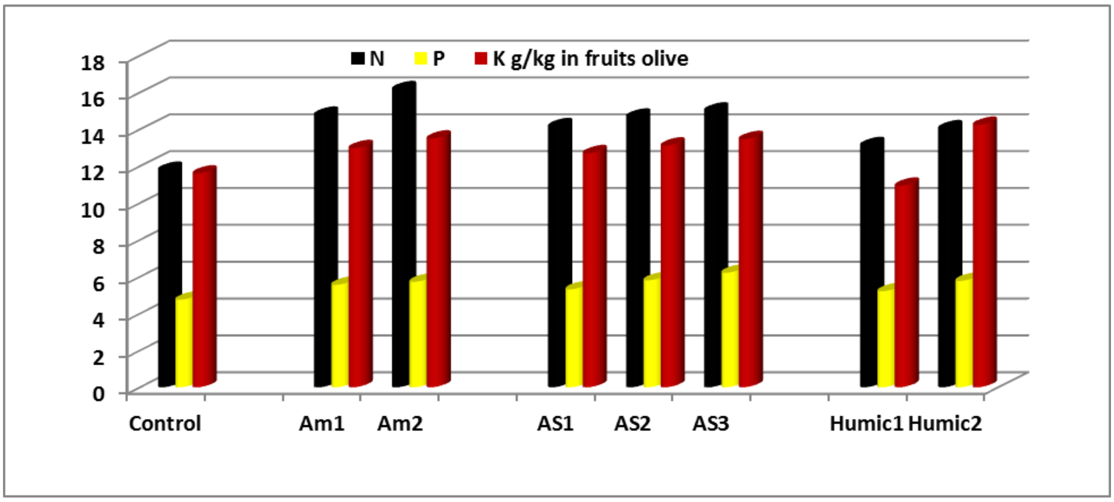

Fig. (5): Effect of organic acids and antioxidants on NPK of fruit olive.

The obtained data in Tables (4 and 5) indicated to the impact of interactions between antioxidants and humic acid and amino acids, Where bilateral interactions surpassed the individual one of the three acids (ascorbic acid, and amino acids humic acid) on nutrients contents in the leaves and fruits of fig and olive trees. The results also indicated that the trilateral interactions were the most influential on nutrients contents in the leaves and fruits of fig trees and olive trees, such also the productivity of figs and olive fruits. Figs (2 and 3) showed that the results confirm the existence higher relationship between the N content in plant and amino acids application as well as the N content increased with increasing amino acids application rates. This may be due to that the amino acids contain an amin groups (NH_2) which containing nitrogen.

The K content in the plant increased with humic acid application rates. Finally, P content in the plant increased with addition of antioxidants this was probably due to participate in the biological processes in the plant. Also the presence of micronutrients increased the enzyme activity which produces the antioxidants; this was leading to increase the antioxidants within the plant, which reflects positively increases the plant's ability to withstand drought stress and salinity. In addition the antioxidants improve the plant growth and raise fruits productivity and quality of the fig and olive trees under conditions of valleys soils in the North West Coast. Therefore, the best treatment ($Amino_2$ $Ascorbic_3$ $Humic_2$) was a trilateral interaction between study factors, which achieved the highest yield components and nutrients contents in the leaves and fruits of fig and olive trees. This may be due to the role of the studied acids (ascorbic acid, and amino acids humic acid) in plant such as the nutrition, regulation plant growth, active participation in the vital processes within the plant, which increased the plant's ability to resist stress caused by drought or salinity conditions, improved the plant growth, increased the productivity and the quality of the fruits of fig and olive. These findings were reported by Canellas and Olivares (2014) and El-Bassiouny *et al.* (2014) for humic acid, Abd El-Samad *et al.* (2010) and Gioseffi *et al.* (2012) for amino acids and Agatia *et al.* (2012), and Brunetti *et al.* (2013) for ascorbic acid.

Regarded to the influence of the studied treatments, the results has confirmed the beneficial effect of antioxidants in a positive impact on productivity and nutrients concentrations in the leaves and fruits of fig and olive trees. Antioxidants appeared the highest effect followed by amino acids then humic acid showed the lowest effect. The amino acids effect increased yield components and the nutrients concentrations in the leaves and fruits of fig and olive trees with increasing foliar application rates, and it has a higher effect than humic acid. This result may be due to the humic and amino acids functions in plant. The previous results agree with those obtained by Yousef *et al.* (2011) Hagagg *et al.* (2010), Hagagg, *et al.* (2013) and El-Sayed *et al.* (2014).

Effect of treatments studied on biochemical of figs and olive trees:

Data in Table (6) explained that the foliar application of amino, humic and ascorbic acids with sufficient mineral fertilization increased total phenols and total antioxidant with sugar and oil content % in figs and olive trees, compared with the control treatment. The total phenols and total antioxidant contents in leaves and fruits of both figs and olive trees increased with increasing amino, humic and ascorbic acids application rates.

Moreover, ascorbic acid treatments showed higher effects for Total phenols, Total antioxidant contents in leaves and fruits of both figs and olive trees than amino and humic acids treatments. In fruits of fig and olive trees sugar and oil contents % increased with increasing application rates of studied factors (ascorbic, amino and humic acids). The effect of trilateral interactions between studied factors were higher for total phenol, total antioxidants in leaves and fruits of fig and olive trees than of bilateral and individual interactions, while individual interactions occurred the lowest one. The sugar contents% in fig fruits and oil contents % in olive fruits illustrate the same trend of total phenols and antioxidants. The most effective treatment ($Amino_2$ $Ascorbic_3$ $Humic_2$) recorded the highest content of biochemical in leaves and fruits of fig and olive trees in comparison with other treatments. On the other side, the concentrations of total phenols and total antioxidant activity in leaves and fruits of olive trees were higher than in figs trees. The above results agreed with those obtained by Sulaiman and Hassan (2011), Mujić *et al.* (2012), Malek and Sanaa (2013) and El-Sayed *et al.* (2014).

In conclusion, under the valleys soils conditions, the foliar application of amino, humic and ascorbic acids (antioxidants) with NPK and micronutrients at one rate was added to all studied treatments (Table 2), the yield components, total antioxidants, total phenol, sugar %, oil % and nutrients concentration of fig and olive trees were increased with increasing the organic acids and antioxidants rates. The beneficial effect of treatments arranged descending by as follows; ascorbic acid (antioxidants) > amino acids > humic acid > control. The most effective treatment was $Amino_2$ $Ascorbic_3$ with $humic_2$ (ascorbic acid at 600 ppm) with amino and humic acids (at 400 ppm), which achieved 41.2 Mg ha^{-1}figs fruits (64 trees/ha) and 18.9ton of olive fruits/fed (100 trees/ha). The foliar application of antioxidants recorded higher increases of yield parameters and nutrients content in leaves and fruits of fig and olive trees than amino acids and humic acid, while the humic acid showed the lowest effect. The effect of trilateral interactions between studied factors (ascorbic, and amino and humic acids) were higher for yield component, nutrients contents, total phenol, total antioxidants in leaves and fruits of fig and olive trees than of bilateral and individual interactions, while the individual interactions showed the lowest effect.

Table (6). Effect of amino, humic and ascorbic acids on biochemical in the fig and olive trees

Treatments		Fig tree					Olive tree				
		T.Antioxidants		T.phenols		Sugar	T.Antioxidants		T.phenols		Oil
		µg ASA/ml		µmol GalA/ml		%FW	µg ASA/ml		µmol GalA/ml		%FW
		Leaf	Fruits	Leaf	Fruits	Fruits	Leaf	Fruits	Leaf	Fruits	Fruits
Humic acid$_1$	Control	248	158	467	293	29.8	279	192	663	384	15.2
	Am_0AS_1	512	379	1086	782	31.3	507	415	1183	827	16.2
	Am_0AS_2	573	438	1177	865	32.5	584	461	1279	918	17.8
	Am_0AS_3	642	497	1281	952	33.4	657	516	1395	987	18.5
	Am_1AS_0	255	171	486	325	31.8	308	214	685	417	17.1
	Am_1AS_1	557	411	1115	812	34.7	532	431	1217	854	18.5
	Am_1AS_2	622	472	1208	895	35.6	612	487	1309	946	19.3
	Am_1AS_3	695	546	1306	987	36.4	685	548	1423	1012	20.8
	Am_2AS_0	273	194	514	347	32.7	332	247	716	445	18.5
	Am_2AS_1	595	451	1164	858	35.7	569	495	1242	892	19.8
	Am_2AS_2	662	514	1269	953	36.3	654	596	1341	983	20.3
	Am_2AS_3	734	583	1373	1028	37.2	719	599	1459	1045	21.5
Humic acid$_2$	Control	267	176	492	330	32.5	336	248	744	473	17.5
	Am_0AS_1	607	425	1137	819	34.5	585	469	1278	920	18.1
	Am_0AS_2	668	581	1238	898	35.4	673	534	1382	1013	19.6
	Am_0AS_3	731	658	1343	995	36.3	748	596	1496	1083	20.9
	Am_1AS_0	287	196	525	366	35.7	369	272	772	507	19.4
	Am_1AS_1	635	464	1178	862	37.9	619	505	1315	958	20.3
	Am_1AS_2	694	538	1276	954	38.5	708	576	1416	1049	21.4
	Am_1AS_3	772	593	1379	1037	39.8	774	637	1513	1114	22.2
	Am_2AS_0	295	218	553	398	37.9	492	293	798	538	20.5
	Am_2AS_1	675	492	1216	917	39.3	655	542	1354	987	21.3
	Am_2AS_2	746	564	1325	1018	40.7	748	605	1463	1073	22.2
	Am_2AS_3	798	631	1432	1076	41.3	819	679	1565	1152	23.5
$LSD_{0.05}$ Humic		19.3	17.2	15.5	13.7	1.01	26	18	28.3	27.6	0.56
$LSD_{0.05}$ Amino		3.2	2.5	3.8	4	0.22	3.9	3.9	3.2	3.1	0.15
$LSD_{0.05}$ Ascorbic		9.2	7.9	17.2	13.6	0.08	7.5	7	14.9	12.3	0.06
$LSD_{0.05}$ HuxAm		4.6	3.6	5.4	5.7	0.31	5.5	5.5	4.5	3	0.14
$LSD_{0.05}$ Hux AS		13	11.2	18.2	14.3	0.11	7.9	9.9	15.8	13	0.09
$LSD_{0.05}$ AmxAS		15.9	13.7	22.2	17.6	0.14	13	12.1	19.3	15.9	0.11
$LSD_{0.05}$ 3factors		16.8	19.4	31.5	24.8	0.19	18.3	17.2	27.3	22.5	0.15

µg ASA/ml= µg of Ascorbic acid/ml extract, µmol GalA/ml= µmol of Gallic acid/ml extract, T=Total

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تأثير الاضافة الورقية للاحماض العضوية ومضادات الاكسدة على محصول وجودة ثمار اشجار التين والزيتون فى بعض وديان الساحل الشمالى الغربى لمصر

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الملخص العربي

اقيمت تجربتين حقليتن فى مزرعتين موجودتين فى الساحل الشمالى الغربى لمصر. ، كانت المزرعة الاولى اشجار زيتون منزرعة فى وادى سنب بينما المزرعة الاخرى اشجار تين فى وادى هاشم والتى تم اختيارهم على اساس التماثل او التجانس بين الاشجار. قوام اراضى هذة المزارع رملية طمبية، المصدر الرئيسى لماء الرى لاشجار التين والزيتون هو ماء المطر الموسمى. بعض اضافات لماء الرى تتوقف على كميات المياة المخزونة فى ابار الوادى، مساحة شجرة الزيتون ١٠٠ م٢ (١٠٠ شجرة/ هكتار)، بينما شجرة التين ١٥٦ م٢ (٦٤ شجرة/ هكتار). الهدف من هذا البحث هو دراسة تاثير الاضافة الورقية للاحماض الامينية وحامض الهيومك ومضادات الاكسدة على ثمار اشجار التين والزيتون تحت ظروف جفاف الماء فى اراضى الساحل الشمالى الغربى.

الاضافة الورقية للاحماض الامينية وحامض الهيومك ومضادات الاكسدة مثل حامض الاسكوربيك مع تسميد معدنى تمت اضافتها، قياسات المحصول، مضادات الاكسدة الكلية والفينولات الكلية و السكريات الكلية % ومحتوى الزيت % وتركيزات العناصر الغذائية فى اشجار التين والزيتون قد زدات مع زيادة معدلات الاضافات الورقية للاحماض الامينية وحامض الهيومك ومضادات الاكسدة. التاثير النافع لاضافة المعاملات على قياسات المحصول ثمار التين والزيتون تم الترتيب كالاتى مضادات الاكسدة > الاحماض الامينية > حامض الهيومك > الكنترول. المعاملة الاكثر تاثيرا كانت هى (Am2AS3 with humic2) حامض الاسكوربيك (٦٠٠ جزء فى المليون) والاحماض الامينية وحامض الهيومك (٤٠٠ جزء فى المليون) والتى حققت 41.2 مليون جرام / هكتار من ثمار التين و18.9 مليون جرام / هكتار من ثمار الزيتون. اضافة مضادات الاكسدة سجل اعلى زيادة فى قياسات المحصول عند مقارنتها بتاثير الاحماض الامينية وحامض الهيومك، بينما حامض الهيومك كان الاقل تأثيرا. تأثير التفاعلات الثلاثية بين عوامل الدراسة (حامض الاسكوربيك، والاحماض الامينية، وحامض الهيوميك) كانت الاعلى لقياسات المحصول، ومحتوى المغذيات، والفينولات الكلية، مضادات الاكسدة الكلية فى اوراق وثمار بالمقارنة بالتفاعلات الثنائية والاحادية بينما التفاعلات الاحادية كانت الاقل تاثيرا.