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Effect of Mycorrhiza, Alga Al-Zuhoor and Foliar Spraying with Bio-Fertilizer on *Eriobotrya aponica* Seedling

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Abstract: The study was conducted in Alsiyahii region of Babylon province to study the effect of Mycorrhiza, seaweed extract (ALGA AL-Zuhoor) and foliar spray with biofertilizer EM1 on vegetative traits and nutrients content in leaf. The experiment included soil application of Mycorrhiza and ALGA (5 ml L^{-1}) and EM1 at 5 and 10 ml L^{-1}. The Mycorrhizae application significantly increased the number of leaves, the leaf area dry matter and chlorophyll and nitrogen content of leaf. The Mycorrhiza and EM1 10 ml L^{-1} also indicated the same trend. The interaction between the Mycorrhiza, ALGA and foliar spray with EM1 10 ml L^{-1} caused significant effect in improving all studied traits compared to the control.

Keywords: Loquat seedling, *Eriobotrya japonica* L., Mycorrhiza, ALGA AL-Zuhoor

In recent years in many countries of the world emphasis is on environmentally friendly processes and technologies to manage the pollution with use of organic fertilizers, biological fertilizers, bacteria, fungi, yeasts, etc. The bio organic improves the physical and chemical properties of soil and increases the activity of microorganisms in the soil that increase the nutrient readiness to plant, which reflects positively on growth (Zaki and Mohamed 2007). Among these Mycorrhiza improves the properties of the soil and increases the readiness of nutrients by forming a symbiotic relationship between the plant roots and soil, which facilitates the transport of nutrients to the plant. It also contributes to the adhesion of soil particles through its secretion of polysaccharide compounds, which increases the susceptibility of the soil to water retention (Driver 2005). Mycorrhiza is also a fungus that spreads rapidly (Badawi 2008). These fungi protect plants from various pathogens (Smith and Read 2008). The seaweed extract also play an important role in plant growth and development as these contain many macro and microelements in addition to growth regulators of auxin, cytokinins and gibberellins. When added to the soil and absorbed by the root system, improve the vegetative growth of the plant as a result of cell division (Abd - EL-Mawgoud et al 2010). The organic fertilizers, EM1 is an effective microorganism natural biological fertilizer produced by the Japanese company. EMRO contains many microorganisms, including lactic acid, actinomycetes bacteria, yeasts and fungi (Anonymous 2005). These fertilizers secrete many growth harmons that accelerates plant growth by supplying with important nutrients (Al-Saidi 2005). Allawi (2013) observed that the adding of Mycorrhiza gave a significant increase in vegetative growth. Ismail and Abdel Sattar (2012) showed when treating olive seedlings with seaweed extract (marine fruit) there was significant increase in vegetative growth and. Strik (2003) concluded that adding seaweed extract to olive trees led to a significant increase in the vegetative growth and chlorophyll content of leaf. Abd-Rahman and Mansoure (2015) concluded that adding EM1 to banana bushes gave a significant increase in vegetative growth traits and also increased the NPK content of leaf. Ahmed et al. (2013) observed that treating Valencia orange cultivar with bio-fertilizer, resulted in significant increase in leaf area, content of chlorophyll and nutrients NPK. The current research aims to observe the effect of ground adding of mycorrhiza and seaweed extract (ALGA) and foliar spraying with EM1 seedlings of *Eriobotrya aponica* on growth and nutrient content in leaf.

MATERIAL AND METHODS

The study was conducted in Alsiyahii region in the Babylon province during 2016 to study the effect of mycorrhiza, ALGA and foliar spray with biofertilizer EM1 on vegetative traits and nutrients content leaf The experiment included three factors, Mycorrhiza seaweed extract (ALGA AL-Zuhoor) at 5 ml $L^{-1}$and foliar spraying with EM1 at 5 and 10 ml L^{-1}. Random soil sample was taken to a depth of 30 cm to study the physical and chemical properties of soil before conducting the research (Table 1). Mycorrhiza was added after digging a hole on the sides of the roots with a depth of 3 to 5 cm, and then covered with soil. ALGA was added to the soil at 5 ml L^{-1} (Table 2). The biofertilizer spraying, was done on two dates: the first spray was sprayed on May 4, 2016 and the second sprayed on May 21, 2016. The spraying was done on the total vegetative of seedlings to complete wetness of

the seedlings. Spraying was conducted early in the morning, and untreated seedlings (control) were sprayed with distilled water only. The experiment was conducted according to the randomized complete block design with 12 treatments (2 x 2 x 3) each replicated three times. The results were analyzed according to the variance analysis and averages were compared using the Genstat 2010 test at 5% probability level.

Vegetative growth: The leaf area (cm^2) was calculated by taking 10 fully-grown leaves from different parts and weighing, and leaf area calculated. The number of leaves was also calculated form10 plant. The chlorophyll content of leaves were determined for ultra-wide leaves by Chlorophyl meter Spade-502 (Minolta Co. LTD Japanese Ltd). The percentage of dry matter was estimated after calculating the fresh weight of the leaves and then dried in the oven at a temperature of 70C°. The weight was recorded when achieved constant weight. The nitrogen was estimated by collecting the leaves from the main fruiting branches that reached full width. It was washed with water and then distilled water and put in perforated paper bags and placed in an electric oven (Oven) at a temperature of 70°C. After drying the leaves forms sample and necks were milled using an electric mill and 0.5 g of each was taken and digested using sulfuric acid and perchloric and get colorless extracts ready.

RESULTS AND DISCUSSION

Number of leaves (leaf plant^{-1}): The treatment with Mycorrhiza significantly gave the highest average in the number of leaves (41.3 leaf plant^{-1}) (Table 3). The bi-interaction between the treatment of Mycorrhizas and foliar

Table 1. Physical and chemical properties of soil

Traits	K	P	N	Soil texture	Sand	Silt	Clay	EC	pH
Percentage	0.91	0.41	1.05	Clay loam	112	321	477	3.72	7.45
Units	%	%	%	.....	gk^{-1}	gk^{-1}	gk^{-1}	dsm^{-1}	.....

Table 2. Components of seaweed extract (ALGA AL-Zuhoor)

Contains auxins, cytokinins, gibberellins, amino acids and carbohydrates	Cu	Zn	Mn	Fe	Mg	K_2O	P_2O_5	N
	12.6	17.5	31	30	32	4	4	4
	ppm	%	ppm	ppm	ppm	%	%	%

Table 3. Effect of mycorrhiza, ALGA AL-Zuhoor, and foliar spraying with bio-fertilizer (EM1) on loquat seedling on average leaf number

Mycorrhiza	ALGA	EM1 ($ml.L^{-1}$)			Average (A*B)
		0	5	10	
Without adding	Without adding	28.1	30.4	31.4	30.0
	Adding	33.7	39.3	40.2	37.7
Adding Mycorrhiza	Without adding	35.1	42.4	41.6	39.7
	Adding	38.1	43.7	47.0	42.9
Average (C)		33.8	39.0	40.0	
LSD (p=0.05)		C	A*B	A*B*C	
		5.33	6.16	10.67	
A*C					Average (A)
		Without adding	30.9	34.9	33.9
		Adding	36.6	43.1	41.3
LSD (p=0.05)			AC=7.54		A=4.35
B*C					Average (B)
		Without adding	31.6	36.4	34.8
		Adding	35.9	41.5	40.3
LSD (p=0.05)			B C=7.54		B=4.35
Mycorrhiza, ALGA and EMI indicate factor A, B and C respectively					

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spraying with EM1 at a concentration of 10 ml L^{-1} indicated significant highest average (44.3 leaf $plant^{-1}$) while the control treatment gave the lowest average (30.9 leaf $plant^{-1}$). The interaction between Mycorrhiza and ALGA and foliar spray with EM1 gave significant higher number of leaves reached (47.0 leaf $plant^{-1}$) compared to control (28.1 leaf $plant^{-1}$).

Leaf area (cm^2): The ground application of Mycorrhiza gave a significant higher leaf area (53.9 cm^2) than in control (Table 4). The interaction between Mycorrhiza and foliar spray with EM1 at a concentration of 10 ml L^{-1} recorded a significant higher leaf area (66.3 cm^2) compared to the control (50.7 cm^2). The interaction treatment between Mycorrhiza, ALGA

Table 4. Effect of Mycorrhiza, ALGA AL-Zuhoor, and foliar spraying with bio-fertilizer (EM1) on loquat seedling on leaf area (cm^2)

Mycorrhiza	ALGA		EM1 ml.L^{-1}		Average (A*B)
Without adding	Without adding	64.2	68.0	71.3	30.0
	Adding	65.8	75.2	73.1	37.7
Adding Mycorrhiza	Without adding	66.8	76.3	79.5	39.7
	Adding	63.5	69.9	71.6	42.9
Average (C)		63.5	69.9	71.6	
LSD (p=0.05)		C	A*B	A*B*C	
		5.29	6.11	10.58	
A*C					Average (A)
		Without adding	60.7	64.1	66.8
		Adding	66.3	75.8	76.3
LSD (p=0.05)			AC=7.48		A= 4.32
B*C					Average (B)
		Without adding	61.5	67.6	67.7
		Adding	65.5	72.2	75.4
LSD (p=0.05)			B C=7.48		B = 4.32

Mycorrhiza, ALGA and EMI indicate factor A, B and C respectively

Table 5. Effect of Mycorrhiza, ALGA AL-Zuhoor, and foliar spraying with bio-fertilizer (EM1) in Loquat seedling on The leaf content of chlorophyll (SPAD)

Mycorrhiza	ALGA		EM1 ml.L^{-1}		Average (A*B)
Without adding	Without adding	23.30	25.22	25.93	24.82
	Adding	28.31	33.43	34.00	31.91
Adding Mycorrhiza	Without adding	29.77	36.33	35.92	34.01
	Adding	32.13	37.00	39.00	36.04
Average (C)		28.38	32.99	33.71	
LSD (p=0.05)		C	A*B	A*B*C	
		4.07	4.70	8.14	
A*C					Average (A)
		Without adding	25.80	29.32	29.96
		Adding	30.95	36.66	37.46
LSD (p=0.05)			AC=5.76		A=3.32
B*C					Average (B)
		Without adding	26.54	30.78	30.93
		Adding	30.22	35.21	36.50
LSD (p=0.05)			B C=5.76		B=3.32

Mycorrhiza, ALGA and EMI indicate factor A, B and C respectively

and EM1 foliar spray resulted in significant higher average leaf area (69.5 cm^2) compared to the control (47.2 cm^2).

Chlorophyll content (SPAD) in leaf: Mycorrhiza application significantly increased chlorophyll of leaf (35.02 SPAD) compared to the control treatment (28.36 SPAD). The application of Mycorrhiza +EMT at 10 ml L^{-1} also recorded higher chlorophyll content (37.46 SPAD) compared to the control treatment that gave (25.80 SPAD) There was significant increase in chlorophyl content with Mycorrhiza in combination with ALGA and foliar spray with EM1 (39.00 SPAD) compared to control (23.30 SPAD).

Dry matter in leaves (%): The results in (Table 6) indicate that the treatment with Mycorrhiza significantly affected raising the average percentage of dry matter in the leaves amounted to (38.16%) compared to the control treatment that gave the lowest average amounted to (29.57%).It is also noted from the same table that there is a significant excelled of the same traits with bi-interaction between the treatment of Mycorrhiza and foliar spray with EM1 at a concentration of 10 ml L^{-1} reached (38.16%) compared to the control treatment amounted to (29.57%), It is also noticed that the triple interaction treatment between Mycorrhiza , ALGA and foliar spray with EM1 at a concentration of 10 ml L^{-1} has a significant excelled effect in the percentage of dry matter in the leaves amounted to (40.21%), while control treatment gave (27.14%)

Nitrogen content of leaf (%): There was significant increase with Mycorrhiza in nitrogen content of leaf (1.34%) compared to the control (1.08%) (Table 7). The bi-interaction between Mycorrhiza and foliar spray by EM1 at 10 ml L^{-1} significantly increased the nitrogen contents (1.41%) as compared to the control (0.95%). The interaction between Mycorrhiza, ALGA and EM1 foliar spray at a concentration of 10 ml L^{-1} also indicated significant increase in nitrogen content of leaf (1.47%) as compared to control (0.76%).

The increase in the vegetative traits and nutrients content of leaves of the as a result of the ground adding of Mycorrhizas can be due to the role that these fungi play in the formation of fungal strands (hypha) and the surface increase due to the complexity of these hyphae which increases the absorption traits of the roots and thus prepares the plant in quantities large nutrients and improve the nutritional status of the plant thus increasing the vegetative growth of the (Al-Tamimi 2000) The increase in the studied traits as a result of adding the seaweed extracts (alga), because the extract contains such regulators as auxin and cytokinins, which play an effective and essential role in cell division and amplitude. It also increases the efficiency of the roots in absorbing nutrients from the soil which in turn contributes to improving the nutritional status of the seedlings and increasing the leaves content of the nutrients (Davies 2004). (Moncuso et al (2006) observed that increase resulting from spraying with fertilizer EM1, may be due to an increase in the efficiency of photosynthesis and increase in the nutrients, reflected positively in the increase in the studied vegetative traits and nutrients content of leaf(Sashi and Rubini 2011). The

Table 6. Effect of Mycorrhiza, ALGA AL-Zuhoor, and foliar spraying with bio-fertilizer (EM1) in Loquat seedling on the percentage of dry matter in leaves (%)

Mycorrhiza	ALGA	EM1 ml.L^{-1}			Average (A*B)
		57.2	60.1	62.3	
Without adding	Without adding	27.14	30.09	36.42	31.22
	adding	32.00	34.74	35.31	34.02
Adding Mycorrhiza	Without adding	33.24	37.63	36.11	35.66
	adding	34.01	38.30	40.21	37.51
Average (C)		31.60	35.19	37.01	
LSD 0.05		C	A*B	A*B*C	
		4.59	5.31	9.19	
A*C					Average (A)
		Without adding	29.57	32.41	35.86
		adding	33.63	37.97	38.16
LSD 0.05			AC= 6.50		A=3.75
B*C					Average (B)
		Without adding	30.19	33.86	36.27
		adding	33.01	36.52	37.76
LSD 0.05			B C= 6.50		B = 3.75

Table 7. Effect of Mycorrhiza, ALGA AL-Zuhoor, and foliar spraying with bio-fertilizer (EM1) in loquat seedling on nitrogen content of leaf (%)

Mycorrhiza	ALGA	EM1(ml.L^{-1})			Average (A*B)
		0	5	10	
Without adding	Without adding	0.76	0.94	1.07	0.92
	Adding	1.14	1.28	1.31	1.24
Adding Mycorrhiza	Without adding	1.21	1.40	1.35	1.32
	Adding	1.24	1.42	1.47	1.37
Average (C)		1.08	1.26	1.30	
LSD (p=0.05)		C	A*B	A*B*C	
		0.12	0.13	0.24	
A*C					Average (A)
		Without adding	0.95	1.11	1.19
		Adding	1.22	1.41	1.41
LSD (p=0.05)			AC=0.17		A=0.09
B*C					Average (B)
		Without adding	0.98	1.17	1.21
		Adding	1.19	1.35	1.39
LSD (p=0.05)			B C= 0.17		B =0.09

interaction treatment, the results showed a positive effect in may be due to the important roles played by the Mycorrhiza, ALGO and EM1 in combination.

CONCLUSION

The interaction between Mycorrhiza and ALGA and EM1 foliar spray combined gave the best results in improving the vegetative traits, and nitrogen and chlorophyll contents in comparison with other treatments and the control treatment, Therefore, recommend treatment with these treatments because these are natural materials and not harmful to the environment compared to chemical compounds, and they also contribute widely to improving the nutritional status of the plant.

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