Effect of Biofertilizer (EM-1) and Organic fertilizer (Acadian) on Vegetative Growth of Many Cultivars of Apricot seedling (*Prunus armeniaca* L.).

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Abstract

This study was conducted in the nurseries of Dept.of Horticulture and Landscape gardening design,Faculty of Agriculture \ University of Kufa ,Iraq-Najaf, during growing season 2016 to find out the impact of add of Biofertilizer (EM-1) with tow levels (1ml/100ml and 2ml/100ml) and organic fertilizer (Acadian) with tow levels (1gm/L and 2gm/L) and compared all treatment with control on the vegetative growth of four apricot seedlings (Kaisy, Labeeb, Zeinni, Baia). The results showed that EM-1 (1ml/100ml) treatmeant caused significant increase in vegetative growth for most cultivars and was nonsignificant for 2ml/100ml treatment for most trails in this experiment compared with control treatment .While Acadian treatments were record too significant increase in some trails compared with control treatment but were less for EM-1 treatments.

Keywords:Apricot, EM, Biofertilizer, Organic fertilizer.

تأثير المخصب الحيوي EM-1 والسماد العضوي Acadian في النمو الخضري لعدة اصناف من شتلات المشمش البذرية (*Prunus armeniaca* L.).

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الخلاصة

أجريت هذه الدراسة في مشاتل قسم البستنة في كلية الزراعة \ جامعة الكوفة خلال موسم 2016 لدراسة تأثير إضافة المخصب الحيوي EM-1 بمستويين (1مل\100مل و 2مل\100مل) والسماد العضوي Acadian بمستويين (1غم\لتر و 2غم\لتر) بالإضافة لمعاملة المقارنة (بدون أضافة) في النمو الخضري لاربعة اصناف من شتلات المشمش البذرية (قيسي ، لبيبب 1 ، زيني و بياع).أظهرت النتائج أن معاملة الشتلات بالمخصب الحيوي EM-1 بتركيز 1مل\100مل سبب زيادة معنوية في صفات النمو الخضري المدروسة ولأغلب الأصناف تحت الدراسة ولم تختلف معنوياً عن معاملة EM-1 بتركيز 2مل\100مل في أغلب الصفات المدروسة مقارنةً بمعاملة المقارنة. بينما سجلت معاملتي السماد العضوي Acadian فارق معنوي في بعض الصفات مقارنة بمعاملة المقارنة الا انها كانت اقل من معاملتي المخصب الحيوي EM-1 اذ توسطت بين معاملتي المخصب الحيوي ومعاملة المقارنة .

الكلمات المفتاحية:مشمش، مخصب حيوي،سماد عضوي

Introduction

Apricot (*Prunus armeniaca* L.) is one of the species of Prunus genus, classified with the Prunoidae sub family of Rosaceae family. According to statistical of food and agriculture organization1 the world areas cultivate apricot trees in 2013 about 400 thousand of hectares, the world production of apricot was 4,038,520 tons, Turkey is the first high production of countries (FAO,2013) . In Iraq, the last statistics indicate that the number of fruit trees equate to 478058 with total production 13479 tons and the average of production per tree equate to 28.2 Kg, Baghdad, Diala and Kerbela are the most

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important regions of apricot production(C.S.O.,2015). Fruits apricot are being not only consuming as fresh but also as dried apricot, frozen apricot, jam, jelly, marmalade, pulp, juice nectar dried and extrusion products etc. Also, apricot kernel is used in production of oil, benzaldhyde, cosmetics, active aroma perfume (Yildiz, 1994).

Using of biofertilizers that contain different microbial strains lead to decrease using of chemical fertilizers and hasprovided high quality products that free harmful agrochemicals for human safety(Mahfouz, S.A. and M.A. Sharaf-Eldin, 2007). Biofertilizers are products containing living cells of different types of microorganisms, which have an ability to convert nutritionally important elements from unavailable to available form through biological processes(Vessey,2003). Biofertilization considered an important factor to reduce the use rates of chemical fertilizers which appear to be safely for environment, improving soil fertility and increase of soil productivity (David,2002). The benefit of using bio-fertilization as chemical fertilizer alternative is due to the activation of *Azospirillum* and *Azotobacter* to fix N gas from soil atmosphere (non-symbiotic N fixer) to become ammonium N, and due to the effect of phosphorylase as an enzyme produced by *Aeromonas* to dissolve the fixed- P in the soil. Biofertilization will help for bring down the costs of chemical fertilizers especially N and P and improve soil fertility by maintaining the good physical conditions of the soil. Biofertilizers consist mainly of beneficial microorganisms that can release nutrients from raw materials and plant residues in the soil and make them available commercially and specifically.(Hoda, 2012). There was a technology introduced by professor Teruo Higa, University of Ryukyus, Okinawa, Japan, who isolated some beneficial micro-organisms from the soil and called them effective microorganism (EM) and marketed by EM Research Organization (Higa, 1986). In addition, EM contains selected species of microorganisms including three principal types of organisms namely lactic acid bacteria, yeast, actinomyces and photosynthetic bacteria that are commonly found in soils (Higa, 1991). All of these are mutually compatible with one another and can coexist in liquid culture (Higa and Wididana, 1991).

EM1 solution, which contains naturally effective micro organisms is capable of enhancing the value of organic matter by accelerating its decomposition and releasing greater quantities of nutrients for crop utilization. (Higa and Wididana, 1991). Applying EM composting fertilizer and EM-activated liquid has been shown to promote root growth and improve the germination potential and germination rate. Spraying rice seedlings with EM liquid can increase the leaf area, stem thickness and chlorophyll content (Xiaohou *et al*., 2008). Wood *et al.* (1997) showed that the beneficial micro organism contained EM1 produce plant hormones, beneficial bioactive substance and antioxidants which solubilizing nutrients. Applying EM composting fertilizer and EM-activated liquid has been shown to promote root growth and improve the germination potential and germination rate. Spraying rice seedlings with EM liquid can increase the leaf area, stem thickness and chlorophyll content (Xiaohou *et al*., 2008). According to APNAN (1995), EM has the effects in agriculture it make increasing the efficacy of organic matter as fertilizers. Ezz *et al.* (2011) revealed that the treated banana with EM1 increased all studied vegetative growth characters of banana (pseudostem height, pseudostem girth, number of green leaves/plant, number of total leaves/plant, leaf length, leaf width, and leaf area) followed generally the same trend.

Organic fertilization as well as using biofertilizers, K and S were very effective in counteracting the adverse effects of salinity on growth, nutritional status and fruiting of crops. This is attributed to the beneficial effects of compost and biofertilizers on enhancing soil fertility and the availability of all nutrients (Nijjar, 1985 and Kannaiyan, 2002), yeast also increase photosynthesis as well as its own higher content from natural hormones like IAA, cytokinins and GA3, B vitamins, amino acids, organic acids and antioxidants(Abou- Zaid , 1984), potassium on enhancing at least 60 different enzymes, root growth, drought and salinity resistance, translocation of sugars and reduce the respiration, water less through regulating the movment opening and closing of stomata which is essential for photosynthesis, water and nutrient transport

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and plant cooling, energy losses and different disorders(Mengel , 1984 and Dibb, 1998), and sulphur on decreasing soil pH, and soil salinity and incraesing the availability of all nutrients, protrein biosynthesis and the activity of sulphur bacteria (Mengel , 1984; Nijjar , 1985 and Miller *et al*., 1990). Application of biofertilizers (Ahmed *et al*., 2007; Abdo, 2008 and Mahfouz, 2011); EM1 (Higa , 1991; Formowitz *et al*., 2007 and Ibrahim , 2012), yeast (Ahmed, 2001; Moustafa and El- Hosseiny , 2001; Abd El- Motty- Elham *et al*., 2010 and Ahmed- Samah, 2011), compost (Abd El- Naby, 2000; Abd El- Naby and Gomaa, 2000; and Mahmoud – Sara , 2008), K (Ebrahiem, *et al*., 1993; Hassan- El Sayada, 2004 and Hussein , 2006) . The present study was initiated to evaluate the effect of different levels of biofertilizer (EM-1) and organic fertiliza (Acadian) and combination between them on vegetative growth contents and of four apricot seedlings(Kaisy, Labeeb, Zeinni, Baia) .

Materials and Methods

This investigation was conducted during the growing season of 2016, the nurseries of Dept.of Horticulture and Landscape gardening design,Faculty of Agriculture \ University of Kufa ,Iraq-Najaf. Apricot (*Prunus armeniaca* L.) seedling, two year old, grown in polyethylene bags containing 3Kg of soil. Table (1) shows the pr0perties of the soil.

Table (1): Some physical and chemical properties of the soil site

Properties	Value
Sand %	41.2
Clay %	38.9
Silt %	19.9
Texture	Sandy Clay
F.C %	18.44
pH	7.88
EC (dS/m)	0.78

Four apricot cultivars were used (Kaisy, Labeeb-1, Zeinni, Baia).The seedlings were added two times; 2 March, 3Aprile 2016 to the soil, with three levels of Biofertilizer (EM-1) (0, 1 and 2 ml/100ml), and three levels of organic fertilizer (Acadian)(marine plant extract) with three levels (0, 1 and 2 gm/L)(table 2 the different contents of the EM1 and Acadien) .

Table(2) Contents of the EM1 and Acadien

Acadien contents		EM contents	
NPK and nutrients (ash)	**45%-55%**	**Photosynthetic bacteria**	***Rhodopseudomonas plustris , Rhodobacter sphacerodes***
Alginic acid	**10%**	**Lactic Acid Bacteria**	***Lactobacillus plantarum, L.casei, Streptococcus lactis***
Mannitol	**4%**	**Yeast**	***Saccharomyces cerevesiae***
Amino acids	**4%**	**Fungi**	***Apergillus, Penicilium***
Pure marine Alga	**50%**		

The seedlings were left under nursery conditions from the nurseries till 1 June, 2016. The experimental was arranged as Randomized Complete Block Design (R.C.B.D) with two variables (EM1 and Acadian) and three replicates with three seedlings per unit , so the total seedlings for per cultivar was 45, and for four apricot cultivars were 180 seedling. The results were analyzed statistically and the comparison were made using Duncan's multiple range test at

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5% probability (Al-Rawi and KhalafAllah, 1980). All the data were tabulated and statistically Analyzed with computer using (Genestate).

Measurement Recorded on 1 June,2016

1- Mean of Plant Length increase (cm): It was measured at the end of investigation 1 June, 2016 using the measuring tape.

2- Mean of Stem Diameter increase (mm): It was measured at 5cm above soil surface using Vernier.

3- Mean of Leaves Number increase per Seedling: Leaves number were calculated in three seedlings randomly chosen from each treatment.

4- Mean of Leaf Area (cm²): The average leaf area of the 6-10th leaves (Reisinaur, 1978) from the apex of transplants under treatment was determined by gravimetric method according to Drovnic *et al*. (1965). After leaves weight was taken, a disc (0.302 cm²) from each leaf was given and weight. They were oven-dried at 70ºc until weight fixing. The average leaf area was then calculated by the following equation:

A.L.A = L.D.W × a.d/d.w.d Where: A.L.A = Average leaf area (cm²). L.D.W = Average leaf dry weight (g) a.d =Average area of disc given from the leaves (0.302 cm²) d.w.d =Average dry weight of discs given from the leaves (g)

5-Leaves Dry matter (%):Leaves Dry Weight (%) After the fresh weight of shoots, leaves determination separately, the leaves were placed in electrical oven at 70˚c until weight fixing (Gobara, 1998). leavesDry matter was calculated as follows:

Leaves dry matter (%) = 100 × Leaves fresh weight/ Leaves Dry weight

6- Total Chlorophyll Content(mg/ g fresh weight): Total chlorophyll was determined in leaf extractions with acetone (80%), filtered with filter pepper and centrifuge for five minutes at 3000 C.h-1 , then light absorption determination with spectrophotometer at 663 and 645 nm were measured. The total chlorophyll was determined according to the following equations.

Total chlorophyll = 20.20 A645 + 8.02 A663

A663 and A645 was the reading of spectrophotometer at 663 and 645 nanometer respectively. (Mackinny,1941 and Arnon,1949)

Results and Discussion

1- Mean of Plant Length increase (cm): Results in table (3) showed that all apricot seedlings that treated significantly increased plant length when treated with 1ml/100ml EM or all apricot cultivars seedling if compared with the other treated seedlings and both treatment of EM (1 and 2 ml/100ml) were nonsignificantly between them for Kaisy and Baia cultivars .

Table (3): Effect of Biofertilizers (EM-1) and organic fertilizers(Acadian) on seedling length increase(cm) of some apricot cultivars .

Treatments		Cultivars			
		Kaisy	Labeeb-1	Zeinni	Baia
Control		34.0 c	37.2 b	26.3 c	33.8 b
EM1	1ml/100ml	51.2 a	48.9 a	48.7 a	55.9 a
	2ml/100ml	49.9 a	40.5 b	35.3 b	42.4
Acadian	1g/L	37.7 b	38.8 b	31.1 bc	35.5 ab
	2g/L	40.2 b	39.0 b	30.8 bc	34.6 ab

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2- Mean of Stem Diameter increase (mm): The treatments 1 and 2 ml/100ml EM1 significantly increased stem diameter for Kaisy, Labeeb-1 and Baia as compared with other treatments,while the organic biofertilizer treatment with Acadian have middle increased among EM1 treatments and untreated seedling (control) (Table 4).

T able (4): Effect of biofertilizers (EM-1) and organic fertilizers (Acadian) on seedling diameter increase(mm) of some apricot cultivars .

Treatments		Cultivars			
		Kaisy	Labeeb-1	Zeinni	Baia
Control		2.22 d	3.31 c	3.33 d	4.09 c
EM1	1ml/100ml	5.51 b	6.76 a	7.52 a	7.79 a
	2ml/100ml	6.00 a	6.81 a	6.97 b	6.68 a
Acadian	1g/L	5.30 b	3.41 c	4.07 c	4.92 b
	2g/L	4.81 c	4.01 b	4.11 c	4.63 bc

3- Mean of Leaves Number increase per Seedling: In table (5) notice it apricot seedlings cultivars (Kaisy, Labeeb, Zeinni and Baia) when treated with 1ml/100ml EM1 significantly increased reached (66.3, 45.9, 43.8 and 70.2 leaf /seedling) respectively if compared with control seedling ,and was this treatment nonsignificant with 2ml/100ml EM1 for Kaisy, Labeeb-1 and Zeini cultivars .

4- Mean of Leaf Area (cm^2): According to table (6) it was found that the application of 1 and 2 ml/100ml EM1 had a significant stimulatory effect on leaf area parameters of Kaisy apricot seedling when the seedlings treated with 1 and 2 ml/100ml EM1 gave the highest value of leaf area reached (14.12 and 12.21 cm2) respectively, while both biofertilezers (1 and 2 ml/100ml EM1) and Organic fertilizer (1 and 1 and 2 g/L Acadian) were nonsignificant among them on leaf area and convergent from control and sometimes nonsignificantly with the other treatments.

5- Leaves Dry matter (%):Table (7) showed that added 1ml/100ml EM1 caused significantly increased in percentage leaves dry matter for all apricot seedling cultivars under this study, and 2ml/100ml EM1 treatment was nonsignificantly from 1ml/100ml for Labeeb-1,Zaini and Baia,while Acadian treatments were middle among highest and lowest value.

6- Total Chlorophyll Content(mg/g F.W): Data in table (8) indicate that the leaves content of total chlorophyll increased significantly with applying the EM1 and Acadian treatments and nonsignificantly for Kaisy, Zaini and Baia cultivars except Labeeb-1 cultivars was EM1 treatments high significantly if compared with Acadian and control treatments.

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T able (5): Effect of biofertilizers (EM-1) and organic fertilizers (Acadian) on seedling mean of leaves number increase per seedling of some apricot cultivars .

Treatments		Cultivars			
		Kaisy	Labeeb-1	Zeinni	Baia
Control		25.7 c	21.4 c	23.3 b	27.7 bc
EM1	1ml/100ml	66.3 a	45.9 a	43.8 a	70.2 a
	2ml/100ml	60.1 a	33.1 ab	40.1 a	41.6 b
Acadian	1g/L	30.3 bc	30.2 b	25.5 b	31.3 bc
	2g/L	35.7 b	32.8 ab	30.3 b	34.4 b

T able (6): Effect of Biofertilizers (EM-1) and Organic fertilizers (Acadian) on seedling mean of leaf area (cm^2) of some apricot cultivars .

Treatments		Cultivars			
		Kaisy	Labeeb-1	Zeinni	Baia
Control		9.48 c	10.33 b	11.12 ab	11.16 a
EM1	1ml/100ml	17.11 a	14.84 a	14.66 a	12.22 a
	2ml/100ml	16.52 a	14.21 a	15.01 a	13.34 a
Acadian	1g/L	12.65 b	12.21 b	13.33 a	13.11 a
	2g/L	13.01 b	12.62 ab	12.96 a	12.95 a

T able (7): Effect of Biofertilizers (EM-1) and Organic fertilizers (Acadian) on seedling Leaves Dry matter (%)of some apricot cultivars .

Treatments		Cultivars			
		Kaisy	Labeeb-1	Zeinni	Baia
Control		30.10 c	33.37 c	36.61 b	34.16 b
EM1	1ml/100ml	55.03 a	47.68 a	48.08 a	41.92 a
	2ml/100ml	49.90 b	47.90 a	49.91 a	39.90 ab
Acadian	1g/L	46.60 b	40.35 b	42.20 ab	36.60 b
	2g/L	45.56 b	38.36 bc	43.60 ab	37.86 ab

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T able (8): Effect of Biofertilizers (EM-1) and Organic fertilizers (Acadian) on seedling Total Chlorophyll Content (mg/g F.W) of some apricot cultivars .

Treatments		Cultivars			
		Kaisy	Labeeb-1	Zeinni	Baia
Control		1.333 b	1.431 c	1.584 b	1.328 b
EM1	1ml/100ml	2.096 a	2.101 a	1.994 a	2.201 a
	2ml/100ml	1.981 a	2.003 a	1.897 a	2.113 a
Acadian	1g/L	1.762 a	1.871 b	1.878 a	1.905 a
	2g/L	1.994 a	1.837 b	1.865 a	1.911 a

These results go in parallel with those of Bussi *et al*., (2003) on apricot "Bergeron" cv., Kabeel *et al*., (2005) on apricot "Canino" cv. , Ibrahim, et al., (2005) on apricot "Canino" cv., El-Naggar (2009) on apricot "Canino" cv., Stino *et al*., (2009) on apricot "Canino" cv., Zhang et al., (2013) on apple and Milošević and Milošević (2015) on apple. The present study represents the positive response and great potential of biofertilizers EM1 in increasing growth of apricot seedlss. Generally, the results showed that the highest values of vegetative growth parameters were obtained with microbial inoculated treatments . It is observed from the above mentioned results in tables (3,4,5,6,7 and 8) that a significant increase occurred in plant length, stem diameter, leaves number, leaf area (cm^2), leaves dry matter(%),total chlorophyll.

The beneficial effect of EM1 application on alleviating the adverse effect on leaf total chlorophyll content may be attributed to their effect on enhancing organic matter, lowering soil pH as well as increased the uptake of water and nutrients (Higa, 1991; Higa and Wididana, 1991), enhancing soil fertility (Formowitz *et al*., 2007 and Ibrahim, 2012). Also, EM1 is restoration of healthy ecosystem in soil (Higa, 1991). Moreover, EM1 application increased number of the soil micro flora i.e. total bacteria, total actinomyces and total fungi which are precursor of indole acetic acid and gibberellins that leads to improve growth of root system, reflected on enhancing the uptake of nutrients thereby improving plant health. The EM-1 leads to the activation of photosynthetical processes (which increases the formation of chlorophyll, protein and the activity of number of enzymes, in particular, increases peroxidase activity) in plants (Winget and Gold, 2007) This is an important factor promoting the growth and development of plants. EM-1 is able to increase the formation of chlorophyll-green pigment, which processes of absorption of solar energy, carbon dioxide and other substances and provides the growth and developments of plants. The higher leaf area may be caused the effect of EM on plant root development, followed by better fostering with nutrients to the plant. This indicates an enhanced biomass production and photosynthetic capacity. A study by Yamada and Xu (2000) argue that EM contains phytohormones or others biologically active substances that cause the delay of senescence of plants and increase photosynthetic. Bio fertilizers are the most importance for plant production and soil as they play an important role in increasing vegetative growth, yield and fruit quality of "Canino" apricot. (Kabeel *et al.*, 2005 and Shddad *et al*., 2005). Therefore, the present study is undertaken to measure the usefulness of supplementing some organic and bio fertilizers with minimal chemical fertilizers doses on growth, chemical constituents, fruiting and quality of apricot trees and to minimize consuming chemical fertilizers. Samah (2002) mentioned that the beneficial effect of biofertilizer in this respect may be attributed to its effect on increasing nitrogen fixation, production of growth promoting substances or organic acids, enhancing nutrient uptake . Moreover, Abou El-Khashab (2002) reported that the increment of plant growth due to inoculation with N fixed bacteria could be attributed to the capability of these organisms to produce growth regulators such as auxins, cytokinins and gibberellins which affect production of root biomass and nutrients uptake.

The same tables (3,4,5,6,7 and 8) also showed that the add of organic fertilizer(Acadian) had a positive effect on all vegetative growth parameters compared with control treatment although were less from EM1 treatments. Using of organic

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fertilizers will benefit not only crops, which have undoubtedly both better output and quality of the nutrients available in organic form, but also environment itself. It is also important to note that all manures improve behavior of several elements in soils through their active groups (fluvic and humic acids) which have the ability to retain the elements in a complex or chelate forms and consequently improve the plant growth as well as quantity and quality of yield(Kabeel *et al*. 2005, Stino *et al.* 2009).

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