IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 7, Issue 11 Ver. I (Nov. 2014), PP 41-52
www.iosrjournals.org

Effect of Some Agro-Management Systems on Growth and Production of Date Palm Off-Shoots under North Sinai Conditions

Sheren Adel Abd-ElHamied
Desert Research Center, Cairo, Egypt.

Abstract: *This study was conducted during two successive seasons (2012 and 2013) at Baloza Experimental Station, Desert Research Center, North Sinai Governorate, Egypt. This research aimed to study the effect of effective microorganisms (EM) applications, and some planting media on improving rooting and growth characteristics of survived Hayany offshoots date palm cultivar in the nursery. The effective microorganisms (EM) applications were 0, 50 and 100 ml/ palm/year. While, planting media were T_1: control treatment (normal sandy soil), T_2: mixture of cattle manure + sandy soil (1:2, v: v), T_3: mixture of goat manure+ sandy soil (1:2, v: v), and T_4: mixture of compost and sandy soil (1:2, v/v). The obtained results cleared that 100 ml of EM application was the best than other levels. Also, Hayany offshoots planted in T_3 recorded the best root performance results as compared with the other planting media. In addition, T_3 under 100 ml EM applications produced the highest offshoots survival ratio, rooting percentages and enhanced the other growth parameters.*

Key words: *Date palm, Hayany date palm cultivar, planting media, effective microorganisms, offshoots, nursery, rooting.*

I. Introduction

Date palm ***(Phoenix dactylifera* L.**) is one of the oldest fruit trees in the world. It's regard to the fruits trees of tropical and subtropical zone. However, the Middle East and North Africa are the major date palm producing areas in the world.

Successful establishment of date palm offshoots is depended on regeneration of a new root system and leaf growth. Many factors are affecting either success or failure of offshoots to establish and survive such as humidity and soil moisture.

A soil conditioner is a product which is added to soil to improve physical and chemical qualities, especially its ability to provide nutrition for plants. Soil conditioners can be used to improve poor soils to be more usable for planting or to rebuild soils which have been damaged by improper management. In addition, to maintain soils in peak condition.

Planting media repair damaged soil and help maintain the soil quality for plant life. Over time soil will become compacted. Planting media help to loosen the soil as well as replenish and maintain nutrients in order to flourish the plants. For the best result it is important to mix the soil and the soil conditioner before planting. Planting media may be containing organic matters. Organic manures improve soil physical conditions such as moisture retention, aggregate soil stability capacity, soil fertility and crop performance. **(Hati *et al.*, 2006).** Organic manures are able to increase the soil microbial biomass and enhance its activity that improves the enzymatic activity in the soil **(Ren *et al*., 1996; Sun 2003; Lv *et al.*, 2005).**

Rooting medium is important in determining the extent of root formation of date palm offshoots. The highest rooting percentages were obtained by perlite + peatmoss (3:1) medium, followed by wood shavings + peatmoss (1:1) and perlite + peatmoss (1:1). Sand medium was inferior to the others studied media **(Al-Mana et *al.*, 1996).** Offshoots planting in a soil mixture of sand, peat moss, vermiculite, and perlite (1:1:1:1) gave the highest survival percentage **(EL-Bahr, 2007). El- Kosary, *et al.*, (2008)** said that (Olive solid waste + sandy soil 1:2, v/v) gave the highest survival percentage and improve rooting, growth characters and mineral content of Zaghloul date palm offshoots in the nursery. In addition, **Aisueni *et al*., (2009)** said that organic manure enhances date palm growth in the nursery.

Effective microorganisms (EM) products had been in the market since 1983 in Japan **(Subba Rao, 2008). Higa (1991)** reported that EM contains selected species of microorganisms including three principal types, namely, lactic acid bacteria, yeast actinomyces, and photosynthetic bacteria that are commonly found in soils. Moreover, EM application increased number of the soil micro flora i.e. total bacteria, total actinomyces and total fungi which are the producers of indole acetic acid and gibberellins leads to improve growth of root system that reflected on enhancing the uptake of nutrients, thereby improving plant health under salinity stress, and consequently improve leaf mineral content **(Higa, 1991).**

In addition, Effective microorganisms (EM) with organic materials can be added to the soil, to stimulate the supply and release of nutrients **Jakubus *et al.*, (2012).** EM is used to improve soil fertility and plant growing conditions **(Higa, 1991 and Higa and Wididana, 1991**).These findings show that the use of EM compost results in richer soils that can improve growth of crops. In addition, EM application causes a distinct acceleration of organic matter mineralization in the soil, increases the volume of the root system of rootstocks and increases the growth of the assimilative surface of leaves. **Zydlik P.and Zydlik Z., (2008).** Adding EM to the soil increased the vegetative growth, leaf area, leaf chlorophyll and leaf mineral values(N, P, K, Fe, Zn, and Mn) as compared with the untreated Le Conte pear tree **(Abd-El-Messeih *et al.*, 2005).** In addition, **Osman et al. (2011)** mentioned that effective microorganisms (EM) application at 1.0 cm3/palm gave the best results in growth of "Bartamuda" date palm. Moreover, **El-Khawaga (2013)** reported that EM application improved growth of date palm cultivars "Sewy", "Zaghloul" and "Hayany". **Amro *et al.*, (2014)** mentioned that effective microorganisms (EM1) application at 90 ml/palm gave the best results in growth and leaf mineral content of "Hayany" date palm. Moreover **Higa (1991) and (Higa and Wididana, 1991)** Saied that enhancement effect of EM on improving growth and leaf minerals content may be attributed to the fact that EM have beneficial effect on lowering soil pH, and increasing the uptake of water and nutrients. **Formowitz *et al.*, (2007) and Ibrahim, (2012)** reported that, EM is enhancing soil fertility.

This investigation aimed to study the best concentration of EM on establishing date palm offshoots in nursery. Also, to test the most suitable planting media for increasing offshoot rooting ability and its growth performance.

II. Materials And Methods

This study was conducted during the two successive seasons of 2012 and 2013 at Baloza Experimental Station, Desert Research Center, North Sinai Governorate, and Egypt. Three levels of EM 0, 50 and 100 ml/ palm/year adding once time by mixing EM with the planting media prior preparing offshoots for planting in both seasons.

Offshoots planting media prepared as follows: T_1: control treatment (normal sandy soil) (Table, 1), T_2: mixture of cattle manure + sandy soil (1:2, v: v), T_3: mixture of goat manure + sandy soil (1:2, v: v) and T_4: mixture of compost and sandy soil (1:2, v/v) (Table, 2).

Hayany offshoots were planted at February of each season. Each treatment was contained 20 offshoots planted with 2 m between offshoots. Each 5 offshoots were dealt as one replicate and each treatment contained four replicates. Finally, each offshoot of Hayany date palm cultivar weights had ranged from 12 to 15 kg after preparing for planting (cleaning from old roots, dry leaves and dipping in Ferbam (Fungicide)).

Table 1: Some physical and chemical properties of the experimental soil.

Particle size distribution (%)			Texture soil	Ec dsm^{-1}	pH	Available nutrients (Cation)					Available nutrients (Anion)			
Sand	Silt	Clay				N %	P %	K %	Ca meg/l	Mg meg/l	CO3	HCO3 meg/l	Cl^-	SO 4
90	5	5	sandy	1.50	8.20	trace	0.44	0.57	2.65	2.40	-	3.85	5.3	5.5

Table 2: Some chemical properties of cattle manure, goat manure and compost.

Properties	Cattle manure	Goat manure	Compost El Neel
organic matter %	54.2	68.2	30.70
N %	1.23	2.61	1.66
P %	0.80	2.40	0.44
K %	0.50	2.70	1.56
C : N	14.20	19.00	18.70

The following data were recorded at the first week of February of the next season i.e. 12 month of planting: offshoots survival percentage, No. of leaves, leaf length, total number of roots, root length, root diameter. Also, leaves N, P, K, Fe, Zn, Cu and Mn contents were recorded as follows; total nitrogen was determined using micro-kjeldahl method according to **(Huphries, 1959)**. Phosphorus was calorimetrically determined using ascorbic acid according to the method described by **(John, 1970)**. Total potassium was determined using flame-Photometer according to **(Brown and Lilleland 1946)**. Fe, Zn, Cu and Mn were estimated by atomic absorption spectrophotometer as described by **Allan and prince (1965)**. Also, the percentages of increasing N, P, K, Fe, Zn, Cu and Mn content were estimated and tabulated.

Statistical analysis

The data were subjected to analysis of variance and Duncan's multiple range tests was used to differentiate means as described by **Duncan (1955)**.The data were tabulated and statistically analyzed according to the spilt plot design **(Snedecor and Cochran 1989).** The percentages were transformed to the arcsine to find the binomial percentages according to (**Steel and Torrie 1980).**

III. Results and Discussion

Survival percentage%

Table 3, cleared that Hayany offshoots survival percentage was insignificantly affected by the three EM applied levels in both seasons. However, high level with EM gave the best survival percentage in both seasons comparing with other concentration (66.67 and 68.67 % in both seasons, respectively).

Regarding planting media effect, Hayany offshoots were affected significantly by different planting media used in both seasons. T_3 (goat manure + sandy soil 1:2, v/v) produced the highest offshoots survival percentage (65.67 and 67.56 % in the first and second seasons, respectively) comparing with other planting media used. Moreover, T_3 was followed in a descending order by T_4, T_2 and T_1 (60.78, 57.56 and 42.56 % in the first season and 62.00, 59.22 and 43.89 % in the second season), respectively.

The obtained data from the interaction between EM application and planting media cleared that, T_3 (goat manure+ sandy soil 1:2, v/v) with 100 ml EM recorded the highest offshoots survival percentage (81.00 and 83.00 % in the first and second seasons). However, the treatment of 0 ml of EM with T_1 recorded the lowest offshoots survival percentages (40.00% in the first and 41.33% in the second seasons).

These results may be due to the application of animal manure to soil that decreases the P sorption capacity and increases the availability of P to plants. This is thought to be result from the cumulative effects of various processes. These processes may include, for example, an increase in soil pH, blockage of P sorption sites by organic products released from the decomposing organic materials and complexation of toxic metal ions (e.g. Mn and Fe) by organic acids **((Easterwood and Sartain, 1990 ; Hue, 1992; Haynes and Mokolobate, 2001).** The immobilization of P by soil microbial biomass in response to added manure may also increase its availability to plants **(Ayaga *et al.*, 2006; Iyamuremye *et al.,* 1996).** Moreover, EM application increased number of the soil micro flora i.e. total bacteria, total actinomyces and total fungi which are the producers of indole acetic acid and gibberellins leads to improve growth of root system that reflected on enhancing the uptake of nutrients, thereby improving plant health under salinity stress, and consequently improve leaf mineral content **(Higa, 1991).**

The obtained results are in agreement with, **(Al-Mana *et al.,* 1996)** who found that the highest rooting percentages were obtained by deferent planting media**.** In addition, **El-Bahr (2007)** who found that offshoots planting in a soil mixture of sand, peat moss, vermiculite and perlite (1:1:1:1) gave the highest survival percentage. **El- Kosary, *et al.,* (2008) El- Kosary, *et al.,* (2008)** who added that the planting media affected significantly on survival percentage of Zaghloul date palm cultivar in the nursery. **El-Khawaga (2013)** reported that EM application improved growth of date palm cultivars "Sewy", "Zaghloul" and "Hayany". **Amro *et al.* (2014)** mentioned that the effective microorganisms (EM) application at 90 ml/palm gave the best results in growth and leaf mineral content of "Hayany"date palm.

Table 3: Effect of EM application and different planting media on survival percentage (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Survival percentage %	
		Season 2012	Season 2013
Effect of EM application			
0 ml		47.75 c	48.92c
50 ml		55.50 b	56.92b
100ml		66.67 a	68.67a
Effect of planting media *			
T_1		42.56d	43.89d
T_2		57.56c	59.22c
T_3		65.67a	67.56a
T_4		60.78b	62.00b
Effect of interaction between EM application and planting media			
EM application	**planting media ***	**Survival percentage %**	
		Season 2012	**Season 2013**
0 ml	T_1	40.00i	41.33k
	T_2	47.00g	49.00hi
	T_3	53.33f	54.33g
	T_4	50.67f	51.00h
50 ml	T_1	43.33h	44.00jk
	T_2	56.67e	57.67f
	T_3	62.67d	65.33d
	T_4	59.33e	60.67e
100 ml	T_1	44.33gh	46.33ij
	T_2	69.00c	71.00c
	T_3	81.00a	83.00a
	T_4	72.33b	74.33b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Rooting parameters (length, diameter and number)

Data presented in Table 4 revealed that all studied root parameters were significantly affected by all treatments in both seasons. It is obvious that adding EM with high level to the soil increased rooting parameters in both seasons.

Planting media were also significantly affected the same rooting parameters mentioned before in both seasons. T_3 (goat manure + sandy soil 1:2, v/v) produced the highest offshoots roots length (35.11 in the 1st and 35.56 (cm) in the 2nd season), roots diameter (0.84 in the 1st and 0.87(mm) in the 2nd seasons) and roots number (41.79 in the 1st and 42.11in the 2nd seasons) comparing with other planting media used.

The interaction between EM application and planting media cleared that, T_3 (goat manure + sandy soil 1:2, v/v) with 100 ml EM recorded the highest offshoots rooting parameters roots length (45.00 (cm) in the both seasons), roots diameter (1.03 in the 1st and 1.07(mm) in the 2nd seasons) and roots number (60.00 in the 1st and 61.00 in the 2nd seasons). However, under 0 ml of EM with T_1 recorded the lowest offshoots rooting parameters, roots length (16.00 and 17.33(cm) in the first and second seasons, respectively) roots diameter (0.31 and 0.33(mm) in the first and second seasons, respectively) and roots number (5.33 in the 1st and 5.00 in the 2nd seasons).

The increase of roots system volume and improving growth of data parameter could be due to the application organic matter mineralization caused by EM treatments that applied in the soil **Zydlik P.and Zydlik Z., (2008).**

These results paralleled with those **Al-Mana *et al.*, (1996)** who proved that the highest rooting percentages affected by the difference of planting media, and with **El- Kosary, *et al.,* (2008)** who added that the planting media affected significantly on root length, root diameter and roots number of Zaghloul date palm cultivar in the nursery. In addition, **Amro *et al.,* (2014)** mentioned that effective microorganisms (EM) application at 90 ml/palm gave the best results in growth of "Hayany" date palm.

Table 4: Effect of EM application and different planting media on length, diameter and number of roots of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Root length (cm)		Root diameter (mm)		Roots number	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		20.33c	21.75c	0.56c	0.57c	18.42c	17.67c
50 ml		28.33b	27.75b	0.68b	0.70b	26.83b	27.17b
100 ml		35.67a	35.58a	0.83a	0.85a	39.00a	39.00a
Effect of planting media *							
T_1		17.22d	18.22d	0.41d	0.43d	7.22d	7.00d
T_2		28.89c	28.22c	0.73c	0.73c	29.44c	29.33c
T_3		35.11a	35.56a	0.84a	0.87a	41.79a	42.11a
T_4		31.22b	31.44b	0.78b	0.79b	33.89b	33.33b
Effect of interaction between EM application and planting media							
EM application	**planting media ***	**Root length (cm)**		**Root diameter (mm)**		**Roots number**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	T_1	16.00j	17.33j	0.31l	0.33i	5.33j	5.00 l
	T_2	19.67hi	20.67h	0.59i	0.59f	17.67h	16.67i
	T_3	24.67g	26.33f	0.69g	0.70e	27.00f	26.33g
	T_4	21.00h	22.67g	0.64h	0.64f	23.67g	22.67h
50 ml	T_1	17.00j	18.00ij	0.41k	0.45h	7.00ij	7.00k
	T_2	29.00f	26.67f	0.72f	0.73e	29.33f	29.33f
	T_3	35.67d	35.33d	0.82d	0.83cd	38.33d	39.00d
	T_4	31.67e	31.00e	0.78e	0.80d	32.67e	33.33e
100ml	T_1	18.67i	19.33hi	0.50j	0.52g	9.33i	9.00j
	T_2	38.00c	37.33c	0.87c	0.88bc	41.33c	42.00c
	T_3	45.00a	45.00a	1.03a	1.07a	60.00a	61.00a
	T_4	41.00b	40.67b	0.93b	0.93b	45.33b	44.00b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Leaf length and leaves number

Data presented in Table 5 revealed that leaf length and leaves number were significantly affected by all treatments in both seasons. It is obvious that adding EM with high level to the soil increased leaf length and leaves number in both seasons.

Planting media were also significantly affected the same parameters, leaf length and leaves number mentioned before in both seasons. T_3 (goat manure + sandy soil 1:2, v/v) produced the highest offshoots leaf length (163.33 in the 1st and 160.78 cm in the 2nd seasons) and leaves number (4.78 in the 1st and 4.44 in the 2nd seasons) as comparing with other soil planting media.

The interaction between EM application and planting media cleared that, T_3 (goat manure + sandy soil 1:2, v/v) with 100 ml EM recorded the highest offshoots leaf length (204.00 in the 1st and 200.00 cm in the 2nd seasons) and leaves number (6.33 in the 1st and 6.00 in the 2nd seasons). However, under 0 ml of EM with T_1 gave the lowest offshoots leaf length (100.00 in the 1st and 99.67cm in the 2nd seasons) and leaves number (2.00 in the both seasons) was recorded.

Adding animal manure to soil decreases the P sorption capacity and increases the availability of P to plants**.** This is thought to result from the cumulative effects of various processes. These processes may include, for example, an increase in soil pH, blockage of P sorption sites by organic products released from the decomposing organic materials and complication of toxic metal ions (e.g. Mn and Fe) by organic acids **((Easterwood and Sartain, 1990; Hue, 1992; Haynes and Mokolobate, 2001)**. The immobilization of P by soil microbial biomass in response to added manure may also increase its availability to plants (**Ayaga *et al., 2006*; Iyamuremy*e et al.,* 1996).** Moreover, EM application increased number of the soil microflora i.e. total bacteria, total actinomyces and total fungi which are the producers of indole acetic acid and gibberellins leads to improvement growth of root system that reflected on enhanced the uptake of nutrients, thereby improving plant health under salinity stress consequently improved leaf mineral content **(Higa, 1991).** Moreover, the application of EM improving growth and leaf minerals content may be attributed to the fact that EM have beneficial effect on lowering soil pH, and increasing the uptake of water and nutrients **(Higa, 1991; Higa and Wididana, 1991)**, and enhancing soil fertility **(Formowitz *et al.,* 2007 and Ibrahim, 2012)**.

These results are parallel with **El- Kosary, *et al.*, (2008)** who added the planting media affected significantly on leaf length and leaves number of Zaghloul date palm cultivar in the nursery. EM application caused a distinct acceleration of organic matter mineralization in the soil and increased the growth of the assimilative surface of leaves **Zydlik P.and Zydlik Z., (2008).** In addition, **Osman *et al.*, (2011)** mentioned that the effective microorganisms (EM) application at 1.0 cm3/palm gave the best results in growth of "Bartamuda" date palm. Moreover, **El-Khawaga (2013)** reported that EM application improved growth of date palm cultivars "Sewy", "Zaghloul" and "Hayany". **Amro *et al.*, (2014)** mentioned that the effective microorganisms (EM) application at 90 ml/palm gave the best results in growth of "Hayany" date palm.

Table 5: Effect of EM application and different planting media on leaf length and leaves number of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		leaf length (cm)		leaves number	
		Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application					
0 ml		114.08c	113.17c	2.75c	2.67c
50 ml		137.58b	137.50b	3.58b	3.50b
100 ml		167.42a	166.42a	4.75a	4.50a
Effect of planting media *					
T_1		104.11d	103.67d	2.11c	2.11c
T_2		139.78c	140.00c	3.78b	3.67b
T_3		163.33a	160.78a	4.78a	4.44a
T_4		151.56b	151.67b	4.11b	4.00b
Effect of interaction between EM application and planting media					
EM application	**planting media ***	**leaf length (cm)**		**leaves number**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	T_1	100.00l	99.67l	2.00h	2.00h
	T_2	113.33i	112.33i	2.67fgh	2.67fg
	T_3	124.33g	122.33g	3.33def	3.00f
	T_4	118.67h	118.33h	3.00efg	3.00f
50 ml	T_1	104.00k	103.00k	2.00h	2.00h
	T_2	133.00f	134.00f	3.67de	3.67e
	T_3	161.67d	160.00d	4.67bc	4.33cd
	T_4	151.67e	153.00e	4.00cd	4.00de
100 ml	T_1	108.33j	108.33j	2.33gh	2.33gh
	T_2	173.00c	173.67c	5.00b	4.67bc
	T_3	204.00a	200.00a	6.33a	6.00a
	T_4	184.33b	183.67b	5.33b	5.00b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Leaf nitrogen, phosphorus and potassium content (g/100g.D.W)

Data in Table 6, 7 and 8 showed significantly increased in leaf nitrogen, phosphorus and potassium content at 12 month of planting in both seasons. However, EM with high level raised significantly the rate of N content (16.67 in the 1st and 16.83 % in the 2nd seasons), P content (13.75 and 14.42 % in the first and second seasons, respectively) and K content (20.75 in the 1s and 20.58% in the 2nd seasons.

In addition, leaf nitrogen, phosphorus and potassium content was affected significantly by different planting media used in both seasons. It was clearly noticed that T_3 increased both of nitrogen, phosphorus and potassium content and rate of increase of nitrogen, phosphorus and potassium comparing with other soil treatments used in both seasons.

The interaction between EM application and planting media showed that, T_3 with high level of EM application was the best treatments that produced the highest nitrogen, phosphorus and potassium content and the rate of N, P and K in offshoots leaves comparing with other interactions used in both seasons.

Generally, these results are in agreement with **(Abd-El-Messeih *et al.*, 2005)** how recorded that adding EM to the soil increased the leaf mineral values; N, P and K as compared with the untreated Le Conte pear tree. In addition, **El- Kosary, *et al.*, (2008)** who added that the planting media affected significantly on leaf mineral content of Zaghloul date palm cultivar in the nursery. **Elias *et al*,. (2009)** added the application of goat manure to soil could also improve the availability of P through enhanced

biological cycling of soil and fertilizer P. **Jakubus *et al.*, (2012)** said that effective microorganisms (EM) with organic materials can be added to the soil to stimulate the supply and release of nutrients.

Table 6: Effect of EM application and different planting media on leaf nitrogen content (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments	Leaves nitrogen content (%)					
	at planting		at 12 month		Increasing rate	
	Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application						
0 ml	1.61 a	1.61a	1.68 c	1.67c	6.83c	6.75c
50 ml	1.61 a	1.61a	1.72 b	1.70b	11.00 b	9.33b
100 ml	1.61a	1.61a	1.77a	1.78a	16.67a	16.83a
Effect of planting media *						
T_1	1.62 a	1.61a	1.65 d	1.64cd	2.89d	3.00d
T_2	1.61 b	1.61a	1.73 c	1.72c	12.00 c	11.67c
T_3	1.60 b	1.60a	1.77 a	1.76a	16.78a	15.56a
T_4	1.60 b	1.60a	1.75b	1.74b	14.33b	13.67b

Effect of interaction between EM application and planting media

EM application	planting media *	Leaves nitrogen content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
0 ml	T_1	1.63a	1.62a	1.64j	1.63i	1.33j	1.00h
	T_2	1.61 a-d	1.61abc	1.68 gh	1.67g	6.67 h	6.33f
	T_3	1.60 d	1.60bc	1.70 f	1.70f	10.67f	10.00e
	T_4	1.60bcd	1.61c	1.69 fg	1.69fg	8.67g	9.67e
50 ml	T_1	1.62 ab	1.60ab	1.65 ij	1.64hi	3.00 i	3.00c
	T_2	1.60 cd	1.61bc	1.72 e	1.71ef	12.33e	10.67de
	T_3	1.61 bcd	1.60ab	1.76d	1.74d	15.33d	12.33d
	T_4	1.60 bcd	1.61abc	1.74 de	1.72de	13.67de	11.33de
100 ml	T_1	1.62abc	1.60abc	1.66hi	1.65h	4.33i	5.00f
	T_2	1.61a-d	1.61abc	1.78c	1.79c	17.00c	18.00c
	T_3	1.60cd	1.60bc	1.85a	1.84a	24.67a	24.33a
	T_4	1.60cd	1.61abc	1.81b	1.81b	20.67b	20.00b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Leaf Iron, Zinc, Cupper and Manganese content %

Concerning the results in Table 9, 10, 11 and 12, data showed significantly increase in leaf iron, zinc, cupper and manganese content at 12 month of planting in both seasons. However, EM with high level raised significantly the rate of iron, zinc, cupper and manganese content in both seasons.

In addition, leaf iron, zinc, cupper and manganese content was affected significantly by different planting media used in both seasons. It was clearly noticed that T_3 increased all of iron, zinc, cupper and manganese content and rate of iron (21.00 in the 1st and 21.22 % in the 2nd seasons), zinc (24.33in the 1st and 24.78 % in the 2nd seasons), cupper (15.44 in the 1st and 15.56 % in the 2nd seasons) and manganese (26.56 % in both seasons) comparing with other soil treatments used.

The interaction between EM applications and planting media showed that, T_3 with high level of EM application was the best treatments that produced the highest iron, zinc, cupper and manganese content and rate of Fe, Zn, Cu and Mn increase in offshoots leaves comparing with other interactions used in both seasons.

Generally, these results are in agreement with **(Abd-El-Messeih *et al.*, 2005)** who said that adding EM to the soil increased the vegetative growth, leaf area, leaf chlorophyll, leaf mineral values Fe, Zn, and Mn as compared with the untreated Le Conte pear tree**.** In addition, **El- Kosary, *et al.*, (2008)** who added that the planting media affected significantly on leaf mineral content of Zaghloul date palm cultivar in the nursery. Effective microorganisms (EM) with organic materials can be added to the soil, to stimulate the supply and release of nutrients **Jakubus *et al*., (2012).**

Table 7: Effect of EM application and different planting media on leaf phosphorus content (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Leaves phosphorus content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		0.22ab	0.22a	0.30c	0.29c	7.75c	7.33c
50 ml		0.23a	0.21ab	0.33b	0.32b	9.83b	11.17b
100 ml		0.21b	0.21a	0.35a	0.35a	13.75a	14.42a
Effect of planting media *							
T_1		0.23a	0.23a	0.28d	0.28d	5.22d	5.22d
T_2		0.22b	0.21b	0.33c	0.32c	10.89c	11.44c
T_3		0.21b	0.20b	0.35a	0.35a	13.56a	14.44a
T_4		0.22b	0.21b	0.34b	0.34b	12.11b	12.78b
Effect of interaction between EM application and planting media							
EM application	**planting media ***	**Leaves phosphorus content (%)**					
		at planting		**at 12 month**		**Increasing rate**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	T_1	0.24a	0.23a	0.27i	0.27j	3.33i	3.67j
	T_2	0.21cd	0.22abc	0.29fgh	0.29hi	8.33g	7.00h
	T_3	0.21cd	0.21bcd	0.31ef	0.31fg	10.00ef	10.00f
	T_4	0.21cd	0.21bcd	0.30fg	0.30gh	9.33fg	8.67g
50 ml	T_1	0.22bc	0.22ab	0.28hi	0.28ij	6.00h	5.67i
	T_2	0.22abc	0.21bcd	0.33de	0.32ef	10.33ef	11.33e
	T_3	0.23ab	0.20cd	0.35c	0.35cd	12.00d	14.67c
	T_4	0.23ab	0.21bcd	0.34cd	0.34de	11.00de	13.00d
100 ml	T_1	0.23abc	0.22abc	0.29ghi	0.28hig	6.33h	6.33hi
	T_2	0.22bc	0.20d	0.36bc	0.36bc	14.00c	16.00b
	T_3	0.20d	0.20d	0.39a	0.39a	18.67a	18.67a
	T_4	0.21cd	0.21bcd	0.37ab	0.37ab	16.00b	16.67b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Table 8: Effect of EM application and different planting media on leaf potassium content (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Leaves potassium content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		0.74a	0.73a	0.85c	0.85c	10.83c	11.58c
50 ml		0.73ab	0.72ab	0.88b	0.88b	15.42b	15.67b
100 ml		0.72b	0.71b	0.93a	0.92a	20.75a	20.58a
Effect of planting media *							
T_1		0.74a	0.75a	0.81d	0.81c	7.00d	6.33d
T_2		0.73b	0.72b	0.90c	0.90b	16.67c	17.78c
T_3		0.72b	0.71b	0.93a	0.92a	20.33a	20.67a
T_4		0.72b	0.71b	0.91b	0.90b	18.67b	19.00b
Effect of interaction between EM application and planting media							
EM application	**planting media ***	**Leaves potassium content (%)**					
		at planting		**at 12 month**		**Increasing rate**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	T_1	0.75a	0.75a	0.80i	0.80h	5.00j	4.33i
	T_2	0.74a-d	0.72cd	0.85g	0.85f	11.33h	12.67f
	T_3	0.73a-d	0.72cd	0.87ef	0.87e	14.00g	15.00e
	T_4	0.73bcd	0.72cd	0.86fg	0.86ef	13.00g	14.33e
	T_1	0.74ab	0.75ab	0.82hi	0.81gh	7.00i	6.00h

50 ml	T_2	0.73bcd	0.72cd	0.89de	0.89d	16.00f	17.33d
	T_3	0.73b-e	0.71d	0.93c	0.92c	20.33d	21.00c
	T_4	0.72de	0.72cd	0.90d	0.90d	18.00e	18.33d
100 ml	T_1	0.74abc	0.73bc	0.83h	0.82g	8.67i	8.67g
	T_2	0.72cde	0.72cd	0.95b	0.95ab	22.67c	23.33b
	T_3	0.71e	0.71d	0.98a	0.97a	26.67a	26.00a
	T_4	0.72de	0.71d	0.97a	0.95b	25.00b	24.33b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Table 9: Effect of EM application and different planting media on leaf iron content (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Leaves iron content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		152.92a	152.33a	162.00c	162.16c	9.08c	9.83c
50 ml		152.25b	151.58a	166.67b	165.92b	14.42b	13.58b
100 ml		151.75b	151.92a	173.17a	173.00a	21.42a	21.08a
Effect of planting media *							
T_1		153.89a	152.89a	159.89d	159.00d	6.00d	5.11d
T_2		152.22b	152.11ab	167.11c	166.56c	14.89c	14.44c
T_3		151.56c	151.33b	172.56a	172.56a	21.00a	21.22a
T_4		151.56c	151.44b	169.56b	170.00b	18.00b	18.56b
Effect of interaction between EM application and planting media							
EM application	**planting media ***	**Leaves iron content (%)**					
		at planting		**at 12 month**		**Increasing rate**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	**T_1**	154.67a	154.33a	159.00i	158.33g	4.33j	4.00h
	T_2	153.00bc	152.67abc	161.33gh	162.00f	8.33h	9.33g
	T_3	152.00cd	151.33c	165.00f	165.00e	13.00f	13.67ef
	T_4	152.00cd	151.00c	162.67g	163.33ef	10.67g	12.33f
50 ml	**T_1**	154.00ab	150.33c	160.00hi	158.67g	6.00ij	5.33h
	T_2	152.00cd	152.33abc	167.33e	167.00d	15.33e	14.67de
	T_3	151.67d	151.67bc	170.67d	170.00c	19.00d	18.33c
	T_4	151.33d	152.00abc	168.67e	168.00d	17.33d	16.00d
100 ml	**T_1**	153.00bc	154.00ab	160.67h	160.00g	7.67hi	6.00h
	T_2	151.67d	151.33c	172.67c	170.67c	21.00c	19.33c
	T_3	151.00d	151.00c	182.00a	182.67a	31.00a	31.67a
	T_4	151.33d	151.33c	177.33b	178.67b	26.00b	27.33b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: goat manure + sandy soil (1:2,v:v) and T_4 : compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each column, row or interaction are not significantly different at 5% level.

Table 10: Effect of EM application and different planting media on leaf zinc content (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Leaves zinc content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		51.08a	51.33a	65.92c	65.83c	14.83c	14.50c
50 ml		50.33b	51.17a	70.00b	70.25b	19.67b	19.58b
100 ml		50.75ab	50.75a	74.33a	74.67a	23.58a	23.92a
Effect of planting media *							
T_1		51.67a	52.22a	61.22d	61.44d	9.56d	9.22d
T_2		50.78b	50.78b	71.33c	71.33c	20.56c	20.56c
T_3		50.33bc	50.33b	74.67a	75.11a	24.33a	24.78a
T_4		50.11c	51.00b	73.11b	73.11b	23.00b	22.78b
Effect of interaction between EM application and planting media							
EM	**planting media ***	**Leaves zinc content (%)**					

application		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
0 ml	T_1	52.00a	52.33a	60.00j	60.33l	8.00i	8.00k
	T_2	51.33ab	51.33abc	65.33h	65.00i	14.00g	13.67i
	T_3	51.00abc	51.00bcd	70.00f	70.00g	19.00f	19.00g
	T_4	50.00c	50.67cd	68.33g	68.00h	18.33f	17.33h
50 ml	T_1	51.00abc	52.33a	60.67j	61.00k	9.67hf	8.67k
	T_2	50.33c	50.33cd	72.33e	72.00f	22.00hi	21.67f
	T_3	50.00abc	50.00d	74.00d	75.00d	24.00e	25.00d
	T_4	50.00bc	52.00ab	73.00de	73.00e	23.00e	23.00e
100 ml	T_1	52.00bc	52.00ab	63.00i	63.00j	11.00cd	11.00j
	T_2	50.67c	50.67cd	76.33c	77.00c	25.67de	26.33c
	T_3	50.00a	50.00d	80.00a	80.33a	30.00de	30.33a
	T_4	50.33bc	50.33cd	78.00b	78.33b	27.67h	28.00b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: Goat manure + sandy soil (1:2,v:v) and T_4 : Compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each Colum, row or interaction are not significantly different at 5% level.

Table 11: Effect of EM application and different planting media on leaf cupper content (%) of Hayany date palm offshoots during 2012 and 2013 seasons.

Treatments		Leaves cupper content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		27.75a	27.92a	35.25c	34.67c	7.50c	6.75c
50 ml		27.67a	27.17b	38.17b	37.75b	10.50b	10.58b
100 ml		27.25a	27.17b	44.17a	43.58a	16.92a	16.42a
Effect of planting media *							
T_1		28.33a	28.44a	33.33d	31.89d	5.00d	3.44d
T_2		27.56b	27.22b	39.78c	39.33c	12.22c	12.11c
T_3		27.11b	26.78c	42.56a	42.33a	15.44a	15.56a
T_4		27.22b	27.22b	41.11b	41.11b	13.89b	13.89b
Effect of interaction between EM application and planting media							
EM application	**planting media ***	**Leaves cupper content (%)**					
		at planting		**at 12 month**		**Increasing rate**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	T_1	28.67a	29.00a	33.00h	31.33j	4.33h	2.33j
	T_2	27.33cd	27.67c	35.67g	35.00h	8.33f	7.33h
	T_3	27.33cd	27.00d	36.33g	36.00g	9.00ef	9.00g
	T_4	27.67bcd	28.00bc	36.00g	36.33g	8.33f	8.33g
50 ml	T_1	28.33ab	28.33b	33.33h	32.00i	5.00gh	3.67i
	T_2	28.33ab	27.00d	38.33f	38.00f	10.00e	11.00f
	T_3	27.00d	26.67d	41.00d	41.00d	14.00d	14.33d
	T_4	27.00d	26.67d	40.00e	40.00e	13.00d	13.33e
100 ml	T_1	28.00abc	28.00bc	33.67h	33.33i	5.67g	4.33i
	T_2	27.00d	27.00d	45.33c	45.00c	18.33c	18.00c
	T_3	27.00d	26.67d	50.33a	50.00a	23.33a	23.33a
	T_4	27.00d	27.00d	47.33b	47.00b	20.33b	20.00b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: Goat manure + sandy soil (1:2,v:v) and T_4 : Compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each Colum, row or interaction are not significantly different at 5% level.

Table 12: Effect of EM application and different planting media on leaf manganese content (%) of Hayany date palm offshoots during 2012 and 2013 season.

Treatments		Leaves manganese content (%)					
		at planting		at 12 month		Increasing rate	
		Season 2012	Season 2013	Season 2012	Season 2013	Season 2012	Season 2013
Effect of EM application							
0 ml		53.08a	53.25a	65.92c	65.33c	12.83c	12.08c
50 ml		52.25ab	51.42b	72.67b	72.08b	20.42b	20.67b
100 ml		51.33a	51.25b	78.00a	77.58a	26.67a	26.33a
Effect of planting media *							
T_1		53.44a	53.33a	61.33d	61.00d	7.89d	7.67d
T_2		52.25b	51.89b	73.89c	73.11c	21.67c	21.22c
T_3		51.56c	51.11c	78.11a	77.67a	26.56a	26.56a
T_4		51.67c	51.56bc	75.44b	74.89b	23.78b	23.33b
Effect of interaction between EM application and planting media							
EM application	**planting media ***	**Leaves manganese content (%)**					
		at planting		**at 12 month**		**Increasing rate**	
		Season 2012	**Season 2013**	**Season 2012**	**Season 2013**	**Season 2012**	**Season 2013**
0 ml	T_1	54.00a	54.00a	60.00l	60.00k	6.00l	6.00k
	T_2	53.00b	53.00b	65.67i	65.00i	12.67i	12.00h
	T_3	53.00b	53.00b	70.67g	70.00g	17.67g	17.00f
	T_4	52.33bc	53.00b	67.33h	66.33h	15.00h	13.33g
50 ml	T_1	53.33ab	53.00b	61.00k	60.67k	7.67k	7.67j
	T_2	52.67b	51.00cd	75.00f	73.67f	22.33f	22.67e
	T_3	51.33d	50.00e	78.33d	78.00d	27.00d	28.00c
	T_4	51.67cd	51.67c	76.33e	76.00e	24.67e	24.33d
100 ml	T_1	53.00b	53.00b	63.00j	62.33j	10.00j	9.33i
	T_2	51.00de	51.67c	81.00c	80.67c	30.00c	29.00c
	T_3	50.33e	50.33de	85.33a	85.00a	35.00a	34.67a
	T_4	51.00de	50.00e	82.67b	82.33b	31.67b	32.33b

*T_1: Control (normal sandy soil), T_2: cattle manure + sandy soil (1:2,v:v), T_3: Goat manure + sandy soil (1:2,v:v) and T_4 : Compost + sandy soil (1:2,v:v).
Means having the same letter (s) in each Colum, row or interaction are not significantly different at 5% level.

CONCLUSION

IT can be concluding from the aforementioned results, that goat manure + sandy soil (1:2,v:v) with 100 ml EM is improving rooting offshoots and their growth characters of Hayany offshoots date palm cultivar in the nursery.

References

[1]. Abd-El-Messeih, W.M., M. Amal El-Seginy and H. Kabeel, (2005). Effect of the EM Biostimulant on Growth and Fruiting of Le Conte Pear Trees in Newly Reclaimed Areas. Alex. Sci. Exchange Journal, 26O2 April-June. Adjusting-controlling soil fertility [J]. Plant Nutrition and Fertilizer Science 9, 406-410.

[2]. Aisueni, N. O. , Ikuenobe C. E., Okolo E. C. and Ekhator F.(2009) Response of date palm (Phoenix dactylifera) seedlings to organic manure, N and K fertilizers in polybag nursery African Journal of Agricultural Research Vol. 4 (3), pp. 162-165, March 2009 Available online at http://www.academicjournals.org/AJAR.

[3]. Allan, B. and S. prince, 1965. Absorption and spectrophotometer. Univ., of Hampshire, Durham, Hampshire

[4]. Al-Mana, F. A.; M. A. El-Hamady; M. A. Bacha and A. O. Abdelrahman (1996). Improving root development on ground and aerial date palm offshoots. Principes. 40: 4, 179-181, 217-219; 3 pl.; 11 ref.

[5]. Amro S.M. Salama, Omima M. El- Sayed and Osama H.M. El Gammal (2014) Effect of Effective Microorganisms (EM) and Potassium Sulphate on Productivity and Fruit Quality of "Hayany" Date Palm Grown Under Salinity Stress IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). Volume 7, Issue 6 Ver. I, PP 90-99 www.iosrjournals.org www.iosrjournals.org 90 | Page.

[6]. Ayaga G, Todd A, Brookes PC (2006) Enhanced biological cycling of phosphorus increases its availability to crops in low-input sub-Saharan farming systems. Soil Biol. Bio chem., 38, 81–90.

[7]. Brown, J. D. and O. Lilleland (1946). Rapid determination of potassium and sodium in plant material and soil extracts by flame photometer Proc. Amer. Soc. Hort. Sci, 48: 341-346.

[8]. Easterwood GW, Sartain JB(1990). Clover residue effectiveness in reducing or thophosphate sorption on ferric hydroxide coated soil. Soil Sci. Soc. Am. J., 54. 1345–1350.

[9]. Elias M. Gichangi; Pearson N. S. Mnkeni and Philip C. Brookes (2009) Effects of goat manure and inorganic phosphate addition on soil inorganic and microbial biomass phosphorus fractions under laboratory incubation conditions Soil Science and Plant Nutrition (2009) 55, 764–771.

[10]. Duncan, D. B., 1955. Multiple range and multiple F Test. Biometrics, 11: 1-42.

[11]. El- Kosary, S.; E. I. Bakr1; I. A. Hussien and A. H Sheren (2008). Effect of the irrigation system and soil components on the growth of date palm offshoots in the nursery. Egyptian Journal of Applied Sciences Zagazig folder 23 Number 8 (b) 602-620)

[12]. El-Bahr, M. K. (2007). Micro propagation of three Egyptian Date Palm Cultivars. The Fourth Symposium on Date palm, Saudi Arabia King Faisal University, AL-Hassa, 5-8 May. P. 158.
[13]. El-Khawaga A.S., (2013). Effect of anti-salinity agents on growth and fruiting of different date palm cultivars. Asian Journal of Crop Science 5(1):65-80.
[14]. Formowitz, B.; Elango, F.; Okumoto, S.; Miiller, T. and Buerert, A., (2007). The role of effective microorganisms in the compositing of banana (Musa spp.) residues. J. of Plant Nutrition and Soil Sci., 170: Issue 5 pp 649 - 656.
[15]. Hati KM, Mandal KG, Misra AK, Gosh PK, Bandyopadhyay KK (2006). Effect of inorganic fertilizer and farmyard manure on soil physical properties, root distribution and water-use efficiency of soybean in Vertisols of central India. Bioresour. Technol. 16: 2182 – 2188.
[16]. Haynes RJ and Mokolobate MS (2001). Amelioration of Al toxicityand P deficiency in acid soils by additions of organic residues: a critical review of the phenomenon and the mechanisms involved. Nutr. Cycl. Agroecosyst., 59, 47–63.
[17]. Higa, T. and Wididana, G.N., (1991). The concept and theories of Effective Microorganisms. In: Parr, J.F., S.B. Hornick and C.E. Whitman (eds.), Proc. First International Conference on Kyusei Nature Farming, US Department of Agriculture, Washington, D.C., pp: 118–124.
[18]. Higa, T., (1991). Effective microorganisms: A biotechnology for mankind. In: Parr, J.F., S.B. Hornick and C.E. Whitman (eds.), Proc First International Conference on Kyusei Nature Farming, pp: 8–14. U.S. Department of Agriculture, Washington, DC.
[19]. Hue NV (1992) Correcting soil acidity of a highly weathered Ultisol with chicken manure and sewage sludge Commun. Soil Sci. Plant Anal., 23, 241–264
[20]. Huphries, E. C. (1959). Mineral components and ash analysis modern methods of plant analysis, edited by K. Peach and U. V. Tracey, Springer Verlag Berlin, 1: 468.
[21]. Ibrahim, W. M. A., (2012). Behaviour of Taimour mango trees to inorganic and organic fertilization and application of EM. Ph. D. Thesis, Fac. of Agric. Minia Univ., Egypt. ISSN 1991-637X © 2009 Academic Journals
[22]. Iyamuremye F, Dick RP, Baham J (1996) Organic amendment and phosphorus dynamics: II. Distribution of soil phosphorus fractions. J. Soil Sci., 161, 436–443.
[23]. Jakubus, M., P. Gajewski and Z. Kaczmarek, (2012). Evaluation of the impact of effective microorganisms (EM) on the solubility of microelements in soil. Journal of Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu - Rolnictwo, 103(589): 93-102.
[24]. John, J. K. (1970). Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid .Soil Sci., 109: 214-220.
[25]. Lv WG, Huang QW, Shen QR (2005). The effect of organic fertilizer and organic-inorganic fertilizer application on soil enzymes activities during watermelon growing period. Journal of Nanjing Agricultural.
[26]. Osman, S. O.A.; Moustafa, F. M. A.; Abd El- Galil, H. A. and Ahmed, A.Y.M., (2011). Effect of yeast and Effective Microorganisms (Em1) application on the yield and fruit characteristics of Bartamuda date palm under Aswan conditions. Assiut J. of Agric. Sci., 42 (Special Issue) (The 5th Conference of Young Scientists Fac. of Agric. Assiut Univ. May,8, 2011) (332-349).
[27]. Ren ZG, Chen YS, Tang FQ (1996) Effect of inorganic fertilizer combined with organic manure on the microflora and enzyme activities in paddy soil. Plant Nutrition and Fertilizer Science 2, 279-283.
[28]. Snedecor, G.W. and W.G. Cochran (1989). In "Statistical Methods". 7th ed., Iowa State Univ. Press. Ames. Iowa, U.S.A., pp 593.
[29]. Steel, R. C. D. and J. H. Torrie (1980). Reproduced from principles and procedures of statistics. Printed with the permission of C. I. Bliss, pp. 448-449.
[30]. Subba Rao, N.S., (2008). Biofertilizers in Agriculture. Oxford IBH Company, New Delhi
[31]. Sun RL, Zhao BQ, Zhu LS (2003) Effects of long-term fertilization on soil enzyme activities and its role in University 28, 67-71.
[32]. Zydlik, P. and Z. Zydlik, (2008). Impact of biological effective microorganisms (EM) preparations on some physic-chemical properties of soil and the vegetative growth of apple-tree rootstocks. Nauka Przyr. Technol., 2: 1, #4.