

## Improving Growth and Productivity of “Sukkary” Mango Trees Grown in North Sinai Using Extracts of Some Brown Marine Algae, Yeast and Effective Microorganisms 1-Mineral content of leaves and fruit growth aspects

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### ABSTRACT

This study was carried out during the two successive seasons of 2012 and 2013 on Sukkary mango trees grown in sandy soil under drip irrigation system at Baloza district, in North Sinai Governorate, Egypt, aiming to study the effect of spraying trees with algae extract at (0, 1 and 2%), yeast extract at (0, 0.2 and 0.3%) with or without effective microorganisms (EM) as a soil treatments on leaf area, chlorophyll content, and N, P, K, Mg, Fe, Zn and Mn contents and physical properties of fruits. The obtained results cleared that spraying with algae at 1% and 2% combined with yeast at 0.3% and with EM gave the best leaf area, leaf chlorophyll, p and Mg. In addition, algae at 2% combined with yeast at 0.3% with EM was very effective to improve levels of N, K, Fe, Zn, and Mn, fruit length, diameter, weight, and volume.

**Key words:** Mango, Algae, yeast, EM, Growth and mineral content

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### Introduction

Mango is one of the important fruits in the tropics and subtropics. In Egypt, mango comes after citrus and grapes as an important popular fruits and cash crops. It is well known that, many problems face and affect mango productivity, (i.e. poor fruit set and high fruit drop percentage at different fruit growth stages especially in the new reclaimed lands). Such trees grown under sandy soil conditions are poorly yielding with low fruit quality due to lacking of their mineral requirements.

Algae extract has a positive effect on growth (Jaswant *et al.*, 1994 and Hegab *et al.*, 2005). Algae extract as a new bio fertilizer containing N, P, K, Ca, Mg, and S as well as Zn, Fe, Mn, Cu, Mo, and Co, some growth regulators, polyamines and vitamins applied to improve nutritional status, vegetative growth in different orchard such as vineyards (Abd El-Migeed *et al.*, 2004; Eman, Abd El-Moniem & Abd-Allah, 2008, Elham, *et al.*, 2010 and Spinelli *et al.*, 2009). Chouliaras *et al.* (2009) recommended the combination of  $\text{NH}_4\text{NO}_3$  + borax + seaweed extract in order to improve growth and nutrition status. Kulk (1995) and Adam (1999) reported that growth promotion in response to application of nitrogen fixer cyanobacterium (*Nostoc muscorn*) could be attributed to the nitrogen's as well as nitrate reductase activities of algae associated with the surface of plants, or the amino acids and peptides produced in algal filtrate and / or other compounds that stimulated growth of crop plants. Mansour *et al.* (2006), investigated the impact of algae extract application to Anna apple trees and found that it was very effective in stimulating the leaf mineral content.

The dry bread yeast (*Saccharomyces cerevisiae*) is a kind of the used biofertilizers for soil or for foliar application on the shoots of vegetable crops (El-Ghamriny *et al.*, 1999) to improve growth of fruit crops (Subba Rao, 2008 and Nijjar, 1985). This is due to its content of many nutrient elements protein, large amount of vitamin B and being productive compounds of semi growth regulators compounds like auxins, gibberellins and cytokinins (Glick, 1995). Moreover, it use also as a natural bio-stimulant appeared to induce an astonished influence on growth of many crops, since it has various basic function, i.e.  $\text{CO}_2$  production as well as formation of alcohol, acids and esters (Magoffin and Hosene, 1974 and Martinez- Anoya *et al.*, 1990). In addition, (Ferguson *et al.*, 1995; Idso *et al.*, 1995 and Hashem *et al.*, 2008) added that application of active dry yeast was very effective in releasing  $\text{CO}_2$  which reflected on improving net photosynthesis.

Active dry yeast at 0.1 % caused a striking improvement in growth of the berries for Red roomy grapes (Ahmed *et al.*, 1997). In apple, dry yeast was very effective in improving leaf area and nutritional status of the trees. (Mansour,1998). In Valencia orange trees, spraying active dry yeast at 0.25 to 0.75% on March or / and August was favorable in improving growth, fruit weight and volume (Hegab *et al.*, 1997 and 2005). However, Elham *et al.*, (2010) showed that spraying mango trees with algae at 2% combined with yeast at 0.2% increased fruit length (cm), fruit width (cm), fruit weight (g), this treatment improved nitrogen and potassium contents in the leaves. On the other hand, all treatments had no effect on leaf phosphorus percentage.

Effective microorganisms (EM) that contains lactic acid bacteria, yeasts, actinomycetes, photosynthetic bacteria and fungi, is one of the most popular microbial technologies that being used worldwide (EM products have been on the market since 1983 in Japan) (Subba Rao, 2008). In a comparative study Jusoh *et al*

(2013) found that EM composts had a higher concentration of nitrogen, potassium, calcium, and iron than the traditional compost. Such major and minor minerals are very important for the growth and metabolism of the plant (Robertson & Vitousek, 2009; Leigh & Wyn Jones, 1984; Kabata-Pendias & Kabata, 1992). Adding EM to the soil increased the vegetative growth, leaf area, leaf chlorophyll, leaf mineral values; N, P, K, Fe, Zn, and Mn, fruit weight and their dimensions as compared with the untreated Le Conte pear tree (Abd-El-Messeih *et al.*, 2005). 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). These findings show that the use of EM composts results in richer soils that can improve growth of crops. In addition, Effective Microorganisms can work in all soil types, all farming systems, and all climates on earth. Its application cause a distinct acceleration of organic matter mineralization in the soil, increase the volume of the root system of rootstocks and increased the growth of the assimilative surface of leaves (Zydlik P. and Zydlik Z., 2008).

Generally, bio-fertilization is very safe for human, animal and environment to get lower pollution and reduce soil salinity via decrease mineral fertilizers usage as well as saving fertilization cost.

This study aimed to improving growth and productivity of "Sukkary" mango trees using extracts of some brown marine algae, yeast and adding effective microorganisms to the soil.

## Materials and Methods

This experiment was carried out during the two successive seasons of 2012 and 2013 on grafted mango trees "Sukkary cv" grown in poor sandy soil (Table 1) under drip irrigation system at Baloza district, North Sinai Governorate, Egypt using extracts of some brown marine algae, yeasts and adding effective microorganisms to the soil.

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

Particle size distribution% (%)			Texture soil	Ec ds/m <sup>1</sup>	Total CaCO <sub>3</sub> %	pH	N %	Available nutrients (Cation)				Available nutrients (Anion)			
Sand	Silt	Clay						P(ppm)	K (meq / l)	Ca(meq / l) meq/l	Mg(meq / l) meq/l	CO <sub>3</sub>	HCO <sub>3</sub> meq/l	Cl <sup>-</sup>	SO <sub>4</sub>
95	5	-	sandy	3.0	5.15	7.9	0.007	0.03	1.0	15.3	3.8	-	3.85	22.3	16.6

Algae extract formulation: Algae extract (oligo-x) obtained from (union for agricultural development) company having the following composition in Table (2).

**Table 2:** Chemical compositions of Algae extract (union for agricultural development).

Oligosaccharide %	alginic acid %	phytin	menthol %	growth regulators			minerals					
				natural Cytokinin %	indol acetic acid%	Pepsin %	potassium oxide %	phosphorus oxide%	N %	Zn %	Fe %	Mn %
3	5	0.003	0.001	0.001	0.0002	0.02	12	0.5	1	0.3	0.2	0.1

Bread yeast that applied in four rates (0.0, 0.2, 0.3 and 0.2% and sprayed alone or in combination with other treatments at the rate of 5L /tree, has the chemical compositions of bread yeast are shown in Table (3) according to Nagodawithana (1991).

**Table 3:** Chemical composition of dry yeast

Protein	47%	Nucleic acids	8%
Carbohydrates	33%	Lipids	4%
Minerals	8%		
Approximate composition of vitamins (mg/g):			
Thiamine	6-100	Biotin	1.3
Riboflavin	35-50	Cholin	4000
Niacin	300-500	Folic acid	5-13
Pyridoxine HCl	28	Vit-B12	0.001
Pantothenate	70		
Approximate composition of minerals (mg/g):			
Na	0.12	Cu	8.00
Ca	0.75	Se	0.10
Fe	0.02	Mn	0.02
Mg	1.65	Cr	2.20
K	21.00	Ni	3.00
P	13.50	Va	0.04
S	3.90	Mo	0.40
Zn	0.17	Sn	3.00
Si	0.03	Li	0.17

The selected trees were uniform in vigor as possible. Fertilization program and other agricultural practices were the same for all trees.

The active dry yeast spraying solution was prepared according to the method described by Attala *et al.* (2000). All trees were sprayed every first of March, May and July using triton B at 0.1 % as a wetting agent.

The experiment was designed as spilt spilt design. Three replicates were used for each treatment and every replicate was represented by three trees with 2x3x3 factorial arrangement of treatments with the following factors and levels: Main factor was adding EM to soil in December (with or without), Sub main was dry yeast at 0% (spraying with water), 0.2% and 0.3%, and sub sub main was alga at 0% (spraying with water), 1% and 2%. Therefore, this experiments included (2x3x3), 18 treatments.

In both seasons and in early April, the third pair of leaves from the base of nun-fruiting shoots of spring growth were selected and tagged according to Qaoud (2005).

The following parameters were measured for both seasons:

1- **Leaf area:** was measured using leaf area meter.

2- **Average total chlorophyll content:** leaves were tested at the end of august in field using Minolta meter SPAD-502.

#### *Macro and Micronutrients:*

ten tagged leaves from each tree were collected carefully at random at the end of September in both seasons. As soon as macro and micronutrients analyzed in mango leaves that collected according to Jones *et al.* (1991), prepared as described by Peterburgski (1968). Total NPK are calorimetrically determined as described by Cottenie, *et al.* (1982). Fe, Zn, Mn and Mg were estimated by atomic absorption spectrophotometer as described by Allan and prince,(1965).

#### *Fruit parameters:*

fruits sample was taken at the harvest time (first of August) to be used for determining the physical and chemical properties (i.e., fruit length (l/cm), fruit diameter (d/cm), fruit weight (w/g) and fruit volume (v/cm<sup>3</sup>).

#### *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).

## **Results and Discussion**

#### *Leaf area:*

Data in Table (4) showed the effect of EM, extract of yeast and algae was significantly affected by treatments in both seasons. It is obvious that adding EM to the soil increased leaf area in both seasons. In addition, spraying extract of yeast at 0.3% gave the highest leaf area significantly in both seasons. Furthermore, spraying extract of algae at 2% produced better leaf area than control (sprayed with water).

On the other hand, the interactions between EM and yeast show that spraying trees with yeast at 0.3% with adding EM to the soil gave the highest leaf area (107.71 cm<sup>2</sup> in first season and 109.18cm<sup>2</sup> in second season).while, the interaction between EM and algae indicated that spraying trees with algae at 1% and 2% using EM was the better than control in first season. On the other hand, spraying trees with algae 2% using EM gave the highest leaf area in the second season. However, the interactions between extract of yeast and algae affected leaf area significantly. The treatment algae 2% and yeast at 0.3% gave the highest value in both seasons.

Regarding the interaction between EM, extract of yeast and algae clear that spraying trees with 1% or 2% algae and yeast at 0.3% using EM gave the best leaf area (109.22cm<sup>2</sup>, 111.78cm<sup>2</sup> &110.67cm<sup>2</sup>, 112.71cm<sup>2</sup>), in both seasons, respectively. On the other hand, control (without EM) gave the less leaf area.

#### *Leaf chlorophyll:*

Data in Table (5) cleared that the effect of EM, extract of yeast and algae was significantly affected by treatments in both seasons. Adding EM to the soil increased leaf chlorophyll content in both seasons compared with untreated soil with EM. Furthermore, spraying extract of yeast at 0.3% gave the best leaf chlorophyll in both seasons. In addition spraying extract of algae at 2% was better in leaf chlorophyll (45.86 in first season, 46.77 in second seasons) as compared with the control.

Moreover, the interactions between EM and yeast cleared that sprayed trees with yeast at 0.3% with adding EM gave the highest leaf chlorophyll in both seasons. On the other hand, the interaction between EM and algae

revealed that spraying trees with algae at 2% using EM was the best treatment. In addition, the control was less in leaf chlorophyll in both seasons. Where, interaction between extract of yeast and algae show that leaf chlorophyll increased with algae at 1% or 2% and yeast at 0.3% in first season (46.42 and 46.68 respectively). On the other side, algae at 2% and yeast at 0.3% in second season gave the highest leaf chlorophyll (47.86).

Table 4: Effect of EM, extract of yeast, algae and interaction on leaf area of Sukkary mango during 2012 and 2013 seasons

Leaf area (cm <sup>2</sup> )																
A- Specific effect of EM, extract of yeast and algae																
EM					Extract of yeast					Extract of algae						
2012		2013			2012		2013			2012		2013				
Without	with	Without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	
73.39	101.22	79.04	102.96	78.55	89.57	93.79	82.10	92.71	98.19	74.75	91.68	95.49	78.91	95.12	98.85	
B	A	B	A	C	B	A	C	B	A	C	B	A	C	B	A	
B-Interactions between EM and extract of yeast																
EM		2012			2013			EM		2012			2013			
		without	with	without	with	without	with	algae		2012			2013			
		Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%
yeast		66.58	90.52	71.10	93.10	62.11	87.39	67.65	90.18	59.45	81.36	83.44	63.581	85.3	87.85	
		F	C	F	C	E	B	F	C	F	E	E	1H	G	G	
0.2%		73.73	105.4	78.83	106.59	76.12	107.2	81.76	108.5	86.03	92.04	96.96	90.05	94.9	100.3	
		E	2B	E	B	D	3A	E	7B	D	C	B	F	8D	3B	
0.3%		79.87	107.7	87.19	109.18	81.95	109.0	87.79	110.1	90.16	95.33	100.9	92.66	97.8	106.3	
		D	1A	D	A	C	3A	D	2A	C	B	8A	E	3C	7A	
C-Interactions between EM and extract of algae																
EM		2012			2013			EM		2012			2013			
		without	with	without	with	without	with	yeast		2012			2013			
		Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%
algae		62.11	87.39	67.65	90.18	59.45	81.36	83.44	63.581	85.3	87.85	73.73	105.4	78.83	106.59	
		E	B	F	C	F	C	E	7B	D	C	B	F	8D	3B	
1%		76.12	107.2	81.76	108.5	86.03	92.04	96.96	90.05	94.9	100.3	79.87	107.7	87.19	109.18	
		D	3A	E	7B	D	C	B	F	8D	3B	D	1A	D	A	
2%		81.95	109.0	87.79	110.1	90.16	95.33	100.9	92.66	97.8	106.3	73.68	106.65	82.00	108.65	
		C	3A	D	2A	C	B	8A	E	3C	7A	h	bc	g	abc	
D-Interactions between extract of yeast and algae																
seasons		2012			2013			seasons		2012			2013			
		Cont.	0.2%	0.3%	Cont.	0.2%	0.3%	EM		2012			2013			
		without	with	without	with	without	with	without	with	without	with	without	with	without	with	
yeast		59.07	59.84	62.52	100.200e	64.74	102.14	61.94	65.21	69.48	101.15	71.53	104.18	43.19	45.46	
		k	k	jk	e	ij	De	n	m	l	f	l	e	C	B	
1%		67.00	105.07	76.68	107.40	84.70	109.22	74.00	106.10	81.00	108.95	90.00	110.67	45.86	46.63	
		i	cd	h	bc	g	ab	k	de	i	bc	g	ab	A	A	
2%		73.68	106.65	82.00	108.65	90.18	111.78	77.33	107.99	86.00	109.66	100.04	112.71	46.42	47.86	
		h	bc	g	abc	f	a	j	cd	h	bc	f	a	B	B	

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level.

Table 5: Effect of EM, extract of yeast, algae and interaction on leaf chlorophyll of Sukkary mango during 2012 and 2013 seasons

Leaf chlorophyll																
A- Specific effect of EM, extract of yeast and algae																
EM					Extract of yeast					Extract of algae						
2012		2013			2012		2013			2012		2013				
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	
43.35	46.32	43.71	47.46	43.6	45.04	45.80	44.26	45.87	46.63	43.19	45.46	45.86	43.76	46.23	46.77	
B	A	B	A	6C	A	A	C	B	A	C	B	A	C	B	A	
B-Interaction between EM and extract of yeast																
EM		2012			2013			EM		2012			2013			
		without	with	without	with	without	with	algae		2012			2013			
		Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%
yeast		42.50	44.82	42.74	45.77	42.03	44.35	42.30	45.22	41.59	43.65	44.39	41.76	44.55	44.10	
		F	C	F	C	E	C	F	C	G	F	E	G	F	E	
0.2%		43.35	46.73	43.74	48.00	43.84	44.08	44.09	48.36	44.50	45.47	46.42	45.31	46.30	47.07	
		E	B	E	B	D	B	E	B	E	C	A	E	C	B	
0.3%		44.21	47.42	44.67	48.60	44.19	47.53	44.75	48.80	44.89	46.01	46.68	45.70	46.76	47.86	
		D	A	D	A	C	A	D	A	D	B	A	D	B	A	
C-Interaction between EM and extract of algae																
EM		2012			2013			EM		2012			2013			
		without	with	without	with	without	with	yeast		2012			2013			
		Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	0.2%	0.3%
algae		41.30	41.88	42.00	45.29	42.80	45.88	41.35	42.17	42.59	46.51	42.96	46.97	43.19	45.46	
		i	k	k	f	j	e	n	m	lm	eg	kl	ef	C	B	
1%		43.00	46.00	43.69	47.24	44.83	48.01	43.24	47.38	44.04	48.56	45.00	49.14	45.86	46.63	
		j	e	i	c	g	ab	jk	de	i	c	h	b	A	A	
2%		43.21	46.57	44.36	47.66	45.00	48.37	43.63	47.77	44.59	48.94	46.04	49.68	46.42	47.86	
		j	d	h	b	fg	a	ij	d	h	bc	g	a	B	B	
D-Interactions between EM, extract of yeast and algae																
seasons		2012			2013			seasons		2012			2013			
		Cont.	0.2%	0.3%	Cont.	0.2%	0.3%	EM		2012			2013			
		without	with	without	with	without	with	without	with	without	with	without	with	without	with	
yeast		41.30	41.88	42.00	45.29	42.80	45.88	41.35	42.17	42.59	46.51	42.96	46.97	43.19	45.46	
		i	k	k	f	j	e	n	m	lm	eg	kl	ef	C	B	
1%		43.00	46.00	43.69	47.24	44.83	48.01	43.24	47.38	44.04	48.56	45.00	49.14	45.86	46.63	
		j	e	i	c	g	ab	jk	de	i	c	h	b	A	A	
2%		43.21	46.57	44.36	47.66	45.00	48.37	43.63	47.77	44.59	48.94	46.04	49.68	46.42	47.86	
		j	d	h	b	fg	a	ij	d	h	bc	g	a	B	B	

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level.

Furthermore, Interactions between EM, extract of yeast and algae shown that spraying trees with 1%, 2% algae and yeast at 0.3% using EM gave the best leaf chlorophyll in first season, but in the second season spraying trees with 2% algae using EM and combined with yeasts at 0.3% gave the highest leaf chlorophyll content. The previous results are agreed with those obtained by Abd El-Wahab (2007) and Osthuyes (1993) who reported that spraying mango trees with algae and yeast extract increased growth. In addition, application of active dry yeast was very effective in releasing CO<sub>2</sub> which reflected on improving net photosynthesis (Ferguson *et al.*, 1995; Idso *et al.*, 1995 and Hashem *et al.*, 2008). The increase in leaf area and leaf chlorophyll content that clearly obvious from the previous results could be due to the effective components of algae and yeast such as major and minor elements, growth regulator and vitamins which enhanced cell division, metabolism and other biological reactions, in addition to the activation effect of these components on photosynthesis and promoting protoplasm formation including RNA and DNA that important for cell division. These idea goes in parallel with those of Adnan Yaqup Yousif (2011) and Fagiria (1997). In addition, dry yeast was very effective in stimulating the leaf area and total leaf carbohydrates (Mansour, 1998 and Mansour *et al.*, 2006). These results are in harmony with those obtained by (Hegab *et al.*, 1997, Chouliaras *et al.* (2009), (Robertson & Vitousek, 2009) and (Abd-El-Messeih *et al.*, 2005). Furthermore, added EM to the soil increased leaf chlorophyll as compared with the untreated Le Conte pear orchard (Abd-El-Messeih *et al.*, 2005). In addition, EM application caused a distinct acceleration of organic matter mineralization in the soil, increased the volume of the root system of rootstocks and increased the growth of the assimilative surface of leaves. Zydlik P. and Zydlik Z., (2008).

**Leaf mineral content:****Nitrogen:**

Results in Table (6) showed that nitrogen content in the leaves was significantly affected by treatments in both seasons. However, specific effect of EM, extract of yeast and algae reveal that adding EM to the soil increased nitrogen content in the leaves (1.32% and 1.36% in both seasons, respectively) compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest nitrogen content in leaves (1.27% and 1.33%) in both seasons respectively. Furthermore spraying extract with algae at 2% was the best to increase nitrogen content in leaves (1.28% in first season and 1.34% in second season) as compared with control (spraying with water).

Furthermore, the interaction between yeast at 0.3% with adding EM to the soil gave the highest nitrogen content in leaves. In addition, interaction between algae at 2% with using EM was the best to increase nitrogen content in leaves in both seasons. On the other hand, interaction between extract of yeast and algae were affected in nitrogen content in leaves positively. It was clearly shown that algae at 2% and yeasts at 0.3% gave the highest value in nitrogen content (1.34% and 1.39%) compared with control (1.05% and 1.09%) in both seasons respectively.

Regarding interaction between algae at 2% and yeast at 0.3% using EM gave the best nitrogen content in the leaves in both seasons. On the other side, control without EM gave the less value of nitrogen content in leaves.

**Phosphorus:**

Data presented in Table (7) showed that phosphorus content in the leaves was significantly affected by treatments in both seasons. However, adding EM to the soil increased phosphorus content in the leaves of mango cv. Sukkary in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest phosphorus content in leaves in both seasons. On the other hand, spraying with extracts of algae at the 2% produced the best phosphorus content in leaves.

Furthermore, the interaction between yeast at 0.3% and treated soil with EM gave the highest phosphorus percentage in leaves. While, the interaction between algae at 2% using EM increased phosphorus content in leaves than control in both seasons. Furthermore, interaction between extract of yeast and algae clearly prove that algae at 1% or 2% and yeasts at 0.3% gave the highest phosphorus content in leaves in the first season. On the other side, spraying trees with 2% algae and yeast at 0.3% using EM gave the best phosphorus content in the leaves in second season.

In addition, interactions between algae at 1%, 2% and yeasts at 0.3% using EM gave the best phosphorus content in the leaves in both seasons.

**Table 6:** Effect of EM, extract of yeast, algae and interaction on nitrogen of Sukkary mango during 2012 and 2013 seasons

N %																
A- Specific effect of EM, extract of yeast and algae																
EM				Extracts of yeast						Extract of algae						
2012		2013		2012		2013		2012		2013		2012		2013		
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	
1.11 B	1.32 A	1.19 B	1.36 A	1.15C	1.22 B	1.27 A	1.21C	1.28 B	1.33 A	1.12 C	1.25B	1.28 A	1.18 C	1.31 B	1.34 A	
B-Interaction between EM and Extract of yeast				C-Interaction between EM and extract of algae						D-Interaction between extract of yeast and algae						
EM	2012		2013		EM	2012		2013		yeast algae	2012		2013			
	without	with	without	with		without	with	without	with		Cont	0.2%	0.3%	Cont	0.2%	0.3%
yeast					algae											
Cont.	1.08 F	1.23 C	1.15 F	1.28C	Cont	1.06 F	1.18 C	1.11 E	1.24 C	Cont	1.05 I	1.15 H	1.17 G	1.09 I	1.21 H	1.24G
0.2%	1.11 E	1.34 B	1.19 E	1.38B	1%	1.12 E	1.37 B	1.22 D	1.40 B	1%	1.20F	1.25 D	1.30 B	1.26F	1.31 D	1.36B
0.3%	1.15 D	1.39 A	1.23 D	1.42A	2%	1.15 D	1.41 A	1.24 C	1.43 A	2%	1.22E	1.27C	1.34 A	1.29E	1.33C	1.39A
E-Interaction between EM, extract of yeast and algae																
seasons	2012						2013									
yeast	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%					
EM	without	with	without	with	without	with	without	with	without	with	without	with				
algae																
Cont.	1.04 p	1.05 op	1.06 no	1.23 g	1.07 mn	1.26 f	1.08 n	1.09 mn	1.11 m	1.30 g	1.15 l	1.33 f				
1%	1.09 lm	1.30 e	1.11 k	1.40 c	1.17 i	1.42 b	1.17 k	1.36 e	1.21 j	1.40 cd	1.27 h	1.44 b				
2%	1.10 kl	1.33 d	1.14 j	1.40 bc	1.20 h	1.48 a	1.19 j	1.39 d	1.25 i	1.42 c	1.28 h	1.49 a				

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level.

**Potassium:**

Data in Table (8) showed that potassium content in the leaves was significantly affected by treatments in both seasons. Adding EM to the soil increased potassium content in the leaves in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest potassium content in both seasons. Furthermore, spraying extract of algae at 2% was better in potassium content than control.

However, the interaction between EM and yeast show that spraying trees with yeast at 0.3% with adding EM to the soil gave the highest potassium content. On the other hand, interaction between algae at 2% using EM was better in potassium content than control in both seasons. In addition, interactions between alga at 2% and yeasts at 0.3% gave the highest value in potassium content.

Regarding Interaction between algae at 2% and yeast at 0.3% using EM gave the best potassium content (1.13% and 1.15%) in both seasons.

Table 7: Effect of EM, extract of yeast, algae and interaction on phosphorus of Sukkary mango during 2012 and 2013 seasons.

P%																	
A- Specific effect of EM, extract of yeast and algae																	
EM				Extract of yeast						Extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013		2013	
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	2%	
0.19	0.26	0.20	0.27	0.21	0.28	0.24	0.21	0.23	0.25	0.19	0.24B	0.25	0.20	0.24	0.25	0.25	
B	A	B	A	C	B	A	C	B	A	C	C	A	C	B	A	A	
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae						D-Interaction between extract of yeast and algae							
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	without	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	0.18	0.23	0.19	0.23	Cont	0.18	0.21	0.18	0.22	Cont	0.17	0.20	0.21F	0.18	0.21	0.22F	
	E	C	E	C		E	C	E	C		H	G	G	H	G	G	
0.2%	0.19	0.26	0.20	0.27	1%	0.20	0.27	0.20	0.28	1%	0.22	0.24	0.25	0.23E	0.24	0.26B	
	DE	B	E	B		D	B	D	B		EF	CD	AB	F	CD	CD	
0.3%	0.20	0.28	0.21	0.29	2%	0.21	0.29	0.21	0.29	2%	0.23	0.25	0.26	0.23	0.25	0.27	
	D	A	D	A		CD	A	d	A		DE	BC	A	DE	BC	A	
E-Interaction between EM, extracts of yeast and algae																	
seasons		2012						2013									
yeast	EM	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		0.3%		0.3%	
		without	with	without	with	without	with	without	with	without	with	without	with	without	with	without	with
Cont.		0.17	0.17	0.18	0.22	0.18	0.24	0.17	0.18	0.18	0.23	0.19	0.25				
		m	m	klm	g	klm	f	lm	lm	klm	fg	klm	ef				
1%		0.19	0.25	0.20	0.27	0.21	0.29	0.19	0.26	0.20	0.28	0.20	0.30				
		ijk	ef	hij	cd	gh	ab	ijk	e	ijk	cd	ab	ab				
2%		0.19	0.26	0.21	0.28	0.22	0.31	0.20	0.27	0.20	0.29	0.23	0.32				
		ijk	de	ghi	bc	g	a	ijkl	de	ijkl	bc	gh	a				

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level.

Table 8: Effect of EM, extract of yeast, algae and interaction on potassium of Sukkary mango trees during 2012 and 2013 seasons

K%																	
A- Specific effect of EM, extract of yeast and algae																	
EM				Extract of yeast						Extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013		2013	
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	2%	
0.96	1.06	0.99	1.07	0.97C	1.02	1.05	0.98C	1.04	1.06	0.92	1.05B	1.07	0.94	1.06	1.08	1.08	
B	A	B	A	C	B	A	C	B	A	C	C	A	C	B	A	A	
B-Interaction between EM and Extract of yeast				C-Interaction between EM and extract of algae						D-Interaction between extract of yeast and algae							
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	without	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	0.94	1.00	0.95	1.00C	Cont	0.86	0.98	0.88	0.99	Cont	0.83	0.95	0.98	0.84	0.98	1.00	
	E	C	E	C		E	D	E	D		H	G	F	H	G	F	
0.2%	0.96	1.09	0.99	1.09B	1%	1.01	1.10	1.03	1.10	1%	1.03E	1.06C	1.07	1.04	1.07C	1.09B	
	D	B	D	B		D	B	C	B		E	C	B	E	C	B	
0.3%	0.99	1.11	1.01	1.12A	2%	1.02	1.11	1.03	1.12	2%	1.04	1.07B	1.09	1.05	1.08B	1.10A	
	C	A	C	A		C	A	C	A		D	C	A	D	C	A	
E-Interaction between EM, extract of yeast and algae																	
seasons		2012						2013									
yeast	EM	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		0.3%		0.3%	
		without	with	without	with	without	with	without	with	without	with	without	with	without	with	without	with
Cont.		0.82	0.83	0.85	1.05	0.90	1.07	0.83	0.84	0.89	1.06	0.93	1.07				
		l	kl	k	f	j	ef	l	l	k	fg	j	ef				
1%		0.98	1.07	1.02	1.09	1.03	1.12	1.00	1.08	1.04	1.04	1.04	1.13				
		i	gh	cd	g	b	a	i	ef	h	cd	h	b				
2%		1.00	1.08	1.02	1.10	1.03	1.13	1.01	1.09	1.04	1.11	1.05	1.15				
		h	de	g	bc	g	a	i	de	h	bc	gh	a				

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level.

Table 9: Effect of EM, extract of yeast, algae and interaction on magnesium of Sukkary mango during 2012 and 2013 seasons

Mg																	
A- Specific effect of EM, extract of yeast and algae																	
EM				extract of yeast						extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013		2013	
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	2%	
0.33	0.40	0.33	0.40	0.33C	0.37	0.39	0.33C	0.38	0.39	0.31	0.38B	0.39	0.32	0.39	0.40	0.40	
B	A	B	A	C	B	A	C	B	A	C	C	A	C	B	A	A	
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae						D-Interaction between extract of yeast and algae							
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	without	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	0.30	0.36	0.30	0.37B	Cont	0.27	0.35	0.28	0.36	Cont	0.26	0.33	0.35	0.26G	0.34F	0.35F	
	F	C	D	B		D	BC	D	BC		H	G	F	G	F	F	
0.2%	0.33	0.41	0.33	0.42A	1%	0.35	0.42	0.35	0.42	0.1%	0.36E	0.38C	0.41	0.37E	0.39C	0.41A	
	E	B	C	A		C	A	C	A		D	AB	D	E	D	B	
0.3%	0.35	0.42	0.36	0.43A	2%	0.36	0.43	0.36	0.43	0.2%	0.37	0.40B	0.41	0.38D	0.40B	0.42A	
	D	A	B	A		B	A	B	A		DE	C	A	E	C	A	
E-Interaction between EM, extract of yeast and algae																	
seasons		2012						2013									
yeast	EM	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		0.3%		0.3%	
		without	with	without	with	without	with	without	with	without	with	without	with	without	with	without	with
Cont.		0.25	0.26	0.27	0.39	0.29	0.40	0.25	0.27	0.28	0.40	0.29	0.41				
		l	kl	k	ef	j	de	l	kl	jk	dfe	j	cde				
1%		0.32	0.41	0.35	0.42	0.38	0.43	0.32	0.41	0.35	0.42	0.39	0.43				
		i	cde	h	abc	fg	ab	i	bcd	h	abc	f	ab				
2%		0.33	0.417	0.37	0.42	0.38	0.44	0.33	0.42	0.37	0.41	0.38	0.44				
		hi	bcd	g	abc	fg	a	hi	abc	g	abc	ef	a				

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level.

**Magnesium:**

Data in Table (9) cleared that magnesium content in the leaves was significantly affected by all treatments in both seasons. Adding EM to the soil increased Mg content in the leaves in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest Mg content in both seasons. Furthermore, spraying extract of algae at the 2% was the better in Mg content than control.

However, interaction between EM and yeast show that spraying trees with yeast at 0.3% with adding EM gave the highest Mg content in first season. While, there is no significantly effect with 0.2% and 0.3% yeast with EM. On the other hand, Interaction between algae 1% and 2% using EM was the better in Mg content than control in both seasons. In addition, interaction between alga at 1% and 2% with yeast at 0.3% gave the highest value of Mg.

Whoever, interaction between EM, extract of yeast and algae clear that spraying trees with 1% and 2% algae with yeast at 0.3% using EM gave the best Mg content in both season

**Iron:**

in Table (10) showed that iron content in the leaves was significantly affected by all treatments in the first and the second season. Adding EM to the soil increased iron content in the leaves in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest iron content in both seasons. Furthermore, spraying extract of algae at 2% was the better in iron content than control.

However, interaction between yeast at 0.3% with EM gave the highest iron content. On the other hand, interaction between EM and algae indicated that spraying trees with 2% algae using EM was better in iron content than control in both seasons. In addition, interaction between extract of yeast and algae affected iron content positively clearing that alga at 2% and yeast at 0.3% gave the highest value.

In addition, interaction between EM, extract of yeast and algae clear that spraying trees with 2% algae and yeasts at 0.3% using EM gave the best iron content (170.10% and 172.11%) in the two respective season of (2012 and 2013).

**Zinc:**

Data in Table (11) cleared that Zinc content in the leaves was significantly affected by all treatments in both seasons. Adding EM to the soil increased Zn content in the leaves in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest Zn content in both seasons. Furthermore, spraying extract of algae at 2% was better in Zn content than control.

However, interaction between yeast at 0.3% using EM gave the highest Zn content. On the other hand, Interaction between EM and algae indicated that spraying trees with 2% algae using EM was better in Zn content than control in both seasons. In addition, interaction between extract of yeast and algae affected Zn content positively clearing that alga at 2% and yeasts at 0.3% gave the highest Zn content.

Regarding, interaction between EM, extract of yeast and algae clear that spraying trees with 2% algae and yeast at 0.3% using EM gave the best Zn (53.35 % and 54.40%) content in both season.

**Table 10:** Effect of EM, extract of yeast, algae and interaction on iron of Sukkary mango during 2012 and 2013 seasons

Fe																
A- Specific effect of EM , extracts of yeast and algae																
EM		Extract of yeast						Extract of algae								
2012		2013		2012		2013		2012		2013		2012		2013		
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	
145.14	157.22	146.23	158.29	145.10	152.34	156.11	146.1	153.46	157.19	142.91	154.27	156.36	143.81	155.31	157.67	
B	A	B	A	C	B	A	4C	B	A	C	B	A	C	B	A	
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae				D-Interaction between extract of yeast and algae								
EM	2012		2013		EM	2012		2013		yeast	2012			2013		
	without	with	without	with		algae	without	with	without		with	algae	Cont	0.2%	0.3%	Cont
yeast					algae					Cont						
Cont.	140.28	149.91	141.41	150.8	Cont	137.76	148.06	138.69	148.93	Cont	132.2	147.5	148.99	133.3	148.5	149.5
	F	C	F	6C		E	D	E	D		4I	1H	G	0I	7H	7G
0.2%	146.31	158.36	147.41	159.5	1%	148.14	160.40	149.33	161.29	1%	150.6	153.9	158.22	151.7	154.9	159.2
	E	B	E	2B		D	B	D	B		7F	1D	B	1F	4D	9B
0.3%	148.81	163.41	149.88	164.5	2%	149.51	163.21	150.68	164.65	2%	152.3	155.5	161.12	153.4	156.8	162.7
	D	A	D	0A		C	A	C	A		7E	9C	A	0E	9C	1A
E-Interaction between EM, extract of yeast and algae																
seasons		2012						2013								
EM	yeast	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%				
		without	with	without	with	without	with	without	with	without	with	without	with			
algae																
Cont.		128.47	136.02q	141.44	153.57	143.37	154.60	129.57	137.03	142.63	154.50	143.87	155.27			
		r	p	p	h	o	g	o	n	m	g	l	g			
1%		145.11	156.23f	148.39	159.43	150.92	165.52	146.15	157.27	149.40	160.48	152.44	166.13			
		n	f	j	j	j	b	k	f	ij	d	h	b			
2%		147.28m	157.47e	149.11	162.07	152.14	170.10	148.52	158.28	150.21	163.57	153.32	172.11			
		k	e	k	c	i	a	j	e	i	e	h	a			

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

Table 11: Effect of EM, extract of yeast, algae and interaction on zinc of Sukkary mango during 2012 and 2013 seasons

Zn																	
A- Specific effect of EM, extract of yeast and algae																	
EM				Extract of yeast						Extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013		2013	
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	Cont	
30.15	43.84	30.75	44.71	31.77	37.96	41.26	32.58	38.36	42.24	29.53	39.73	41.73	30.59	40.37	42.23		
B	A	B	A	C	B	A	C	B	A	C	B	A	C	B	A		
B-Interaction between EM and extract of yeast																	
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	without	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	26.30	37.23	26.90	38.26	Cont.	23.98	35.08	24.92	36.26	Cont.	22.24	32.28	34.09	23.26	33.20	35.31	
	F	C	F	C		F	C	F	C		I	H	G	I	H	G	
0.2%	30.58	45.34	31.06	45.67	1%	32.26	47.19	32.69	48.05	1%	35.77	39.71	43.70	36.67	39.81	44.64	
	E	B	E	B		E	B	E	B		F	D	B	F	D	B	
0.3%	33.56	48.95	34.29	50.20	2%	34.20	49.25	34.63	49.82	2%	37.29	41.90	45.99	37.82	42.08	46.78	
	D	A	D	A		D	A	D	A		E	C	A	E	C	A	
E-Interaction between EM, extract of yeast and algae																	
seasons		2012						2013									
yeast	EM	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		Cont.		0.3%	
		without	with	without	with	without	with	without	with	without	with	without	with	without	with		
Cont.	r	21.66	22.81	24.37	40.18h	25.92	42.26	22.59	23.16	25.33	42.07	26.85	43.77				
		r	q	p		o	g	q	p	o	g	n	f				
1%	n	28.01	43.54	32.64	46.78d	36.15	51.25	28.37	44.96	32.85	46.77	36.85	52.42				
		n	f	l		j	b	m	e	k	d	i	b				
2%	m	29.25	45.33	34.73	49.07c	38.62	53.35	29.74	44.90	35.10	49.16	39.16	54.40				
		m	e	k		i	a	l	d	j	c	h	a				

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

### Manganese:

Data in Table (12) revealed that manganese content in the leaves was significantly affected by all treatments in both seasons. Manganese content in the leaves in both seasons was increased when adding EM to the soil. In addition, spraying extract of yeast at 0.3% gave the highest Mn content in both seasons.

Furthermore, spraying extract of algae at 2% was the better in Mn content than control. However, interaction between yeast at 0.3% with adding EM gave the highest Mn content. On the other hand, Interaction between EM and algae indicated that spraying trees with 2% algae using EM was better in Mn content than control in both seasons. In addition, interaction between extract of yeast and algae affected in Mn content positively clearing that alga at 2% and yeasts at 0.3% gave the highest value of Mn content.

However, interactions between EM, extracts of yeasts and algae clear that spraying trees with 2% algae and yeasts at 0.3% using EM gave the best Mn content in both season. From the above results, it could be concluded that the presence of micro elements and growth regulator, protein, carbohydrates, vitamins and folic acid in yeast and algae extract and the content of EM may have a positive effect on increasing leaf micro elements. Adding EM to the soil increased the leaf mineral values; N, P, K, Mg, Fe, Zn and Mn as compared with the untreated of Le Conte pear trees (Abd-El-Messeih *et al.*, 2005). These results are in agreement with those reported by Suriabanant (1992); Hegab *et al.* (2005), Stino *et al.* (2009) and Elham *et al.*, (2010), Mansour *et al.* (2006), Jakubus *et al.* (2012) and Zydlik P. and Zydlik Z., (2008).

Table 12: Effect of EM, extract of yeast, algae and interaction on manganese of Sukkary mango during 2012 and 2013 seasons

Mn																	
A- Specific effect of EM, extract of yeast and algae																	
EM				Extracts of yeast						Extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013		2013	
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%	Cont	
41.26	54.92	41.90B	55.57A	43.17	48.99	52.11	43.94	49.57	52.69	40.72	50.90	52.65	41.01	51.60	53.58		
B	A	B	A	C	B	A	C	B	A	C	B	A	C	B	A		
B-Interaction between EM and extract of yeast																	
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	without	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	37.95	48.39	38.7	49.30	Cont.	35.45	45.90	35.78	46.24	Cont.	33.78	43.15	45.26	34.04	43.51	45.48	
	F	C	F	C		F	C	E	C		I	H	G	I	H	G	
0.2%	41.53	56.45	42.17	56.97	1%	43.11	58.69	43.91	59.29	1%	46.97	51.16	54.57	47.88	51.65	55.28	
	E	B	E	B		E	B	D	B		F	D	B	F	D	B	
0.3%	44.30	59.92	44.95	60.43	2%	45.12	60.18	46.00	61.17	2%	48.77	52.66	56.51	49.90	53.55	57.31	
	D	A	D	A		D	A	C	A		E	C	A	E	C	A	
E-Interaction between EM, extract of yeast and algae																	
seasons		2012						2013									
yeast	EM	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		Cont.		0.3%	
		without	with	without	with	without	with	without	with	without	with	without	with	without	with		
Cont.	r	33.11	34.44	35.77	50.53	37.74	52.73	33.07	35.00	36.31	50.72	37.96	53.00				
		r	q	p	h	o	g	r	q	p	h	o	g				
1%	n	39.26	54.68	43.75	58.57	46.33	62.81	40.00	55.77	44.19	59.10	47.55	63.00				
		n	f	l	d	j	b	n	f	l	d	j	b				
2%	m	41.48	56.06	45.07	60.25	48.82	64.21	42.65	57.14	46.00	61.10	49.33	65.28				
		m	e	k	c	i	a	m	e	k	c	i	a				

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

### Fruit length:

Concerning the results in Table (13), fruit length was significantly affected by all treatments in both seasons. It is cleared that adding EM to the soil increased fruit length in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest fruit length in both seasons. Furthermore, spraying extract of algae at 2% was the better fruit length than control in both seasons.

On the other hand, interaction between yeast at 0.3% with adding EM to the soil gave the highest fruit length. Moreover, interaction between algae at 2% using EM was the best fruit length (10.83 cm and 11.42 cm) in both seasons respectively. In addition, interaction between algae at 2% and yeast at 0.3% gave the highest value fruit length in both seasons.

While, interaction between EM, extract of yeast and algae clear that spraying trees with 2% algae and yeast at 0.3% using EM gave the best fruit length in both season. On the other hand, control without EM gave the lowest fruit length.

#### Fruit diameter:

Data in Table (14) revealed that fruit diameter was significantly affected by all treatments in both seasons. Adding EM to the soil increased fruit diameter in both seasons compared with untreated soil. In addition, spraying extract of yeast at 0.3% gave the highest fruit diameter in both seasons. Furthermore, spraying extract of algae at the 2% was the best in fruit diameter as compared with control.

On the other hand, interaction between yeast at 0.3% with adding EM gave the highest fruit diameter in both seasons (8.56 cm and 9.07 cm). Moreover, Interaction between algae at 2% using EM was the best in fruit diameter in both seasons. In addition, interaction between algae at 2% and yeast at 0.3% gave higher values of fruit diameter as compared with control in first season. While, non significant effect occurred with algae at 1% or 2% using yeasts at 0.3% in second season.

Furthermore, interaction between algae at 2% and yeast at 0.3% using EM gave the best fruit diameter in both seasons. On the other hand, control without EM gave the lowest fruit diameter. These results are in agreement with those reported by (Abd-El-Messeih *et al.*, 2005) who recorded that EM to the soil increased fruit dimensions as compared with the untreated of Le Conte pear trees. In addition, Elham *et al.*, (2010) who recorded that spraying mango trees with algae at 2% combined with yeast at 0.2% increased fruit length (cm) and fruit width (cm).

Table 13: Effect of EM, extract of yeast, algae and interaction on fruit length of Sukkary mango during 2012 and 2013 seasons

Fruit length (cm)																			
A- Specific effects of EM, extract of yeast and algae																			
EM				Extract of yeast						Extract of algae									
2012		2013		2012			2013			2012		2013			2012		2013		
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%				
9.32	10.25	9.63	10.70	9.31	9.86	10.18	9.73	10.20	10.56	9.20	9.93	10.22	9.54	10.32	10.63				
B	A	B	A	C	B	A	C	B	A	C	B	A	C	B	A				
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae						D-Interaction between extract of yeast and algae									
EM	2012		2013		EM	2012		2013		yeast	2012			2013					
	without	with	without	with		algae	without	with	without		with	algae	Cont	0.2%	0.3%	Cont	0.2%	0.3%	
Cont.	8.94	9.68	9.37	10.08	Cont.	8.81	9.59	9.26	9.82	Cont.	8.50	9.51F	9.58	8.99	9.77	9.86			
	F	C	E	C		D	C	D	C		G	EF	EF	G	F	F			
0.2%	9.47	10.25	9.72	10.67	1%	9.52	10.33	9.79	10.85	1%	9.64E	9.97C	10.19	9.99	10.38	10.60			
	E	B	D	B		C	B	C	B		D	C	B	E	C	B			
0.3%	9.55	10.81	9.79	11.33	2%	9.60	10.83	9.84	11.42	2%	9.78	10.09	10.78	10.20	10.45	11.23			
	D	A	D	A		C	A	C	A		D	B	A	D	C	A			
E-Interaction between EM, extract of yeast and algae																			
seasons	2012						2013												
yeast	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		
EM	without	with	without	with	without	with	without	with	without	with	without	with	without	with	without	with			
algae	Cont.	8.00	9.00	9.16	9.85	9.26	9.90	8.68	9.31	9.51	10.03	9.59	10.12						
	m	l	kl	ef	jk	gf	m	l	k	fg	jk	f							
1%	9.35	9.93	9.60	10.34	9.66	10.71	9.68	10.29	9.83	10.92	9.85	11.34							
	ij	de	gh	c	g	b	ij	e	hi	c	hi	b							
2%	9.46	10.10	9.62	10.55	9.73	11.83	9.76	10.64	9.84	11.07	9.92	12.54							
	hi	d	gh	b	fg	a	hi	d	hi	c	gh	a							

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

Table 14: Effect of EM, extract of yeast, algae and interaction on fruit diameter of Sukkary mango during 2012 and 2013 seasons

Fruit diameter (cm)																			
A- Specific effects of EM, extract of yeast and algae																			
EM				extract of yeast						extract of algae									
2012		2013		2012			2013			2012		2013			2012		2013		
without	With	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%				
7.68	8.23	8.32	8.76	7.74	8.01	8.10	8.32	8.52	8.76	7.62	8.09	8.22	8.21	8.61	8.78				
B	A	B	A	C	B	A	C	B	A	C	B	A	C	B	A				
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae						D-Interaction between extract of yeast and algae									
EM	2012		2013		EM	2012		2013		yeast	2012			2013					
	without	with	without	with		algae	without	With	without		with	algae	Cont	0.2%	0.3%	Cont	0.2%	0.3%	
Cont.	7.50	7.97	8.16	8.48C	Cont.	7.39	7.84	8.01	8.40	Cont.	7.20	7.77F	7.89	7.85G	8.32F	8.47E			
	E	C	E	C		D	C	E	D		G	F	E	G	F	E			
0.2%	7.72	8.30	8.34	8.71B	1%	7.79	8.39	8.45	8.78	1%	7.97	8.11B	8.19	8.52E	8.62C	8.70A			
	D	B	D	B		C	B	CD	B		DE	C	B	D	D	B			
0.3%	7.80	8.56	8.45	9.07A	2%	7.83	8.60	8.49	9.08	2%	8.05	8.14	8.47	8.59D	8.65B	9.11A			
	D	A	C	A		C	A	C	A		CD	BC	A	D	C	A			
E-Interaction between EM, extract of yeast and algae																			
seasons	2012						2013												
yeast	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		
EM	without	with	without	with	without	With	without	with	without	with	without	with	without	with	without	with			
algae	Cont.	7.08	7.30	7.51	8.03	7.59	8.18	7.74	7.95	8.04	8.60	8.26	8.68						
	m	l	k	f	jk	e	m	l	k	f	j	e							
1%	7.68	8.25	7.81	8.41	7.88	8.50	8.33	8.70	8.48	8.76	8.52	8.87							
	ij	de	ghi	bc	gh	b	i	de	gh	cd	fg	b							
2%	7.75	8.34	7.84	8.45	7.94	9.00	8.41	8.77	8.49	8.81	8.56	9.66							
	hi	cd	gh	bc	fg	a	hi	cd	g	bc	fg	a							

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

**Fruit weight:**

It is evident from Table (15) that fruit weight was significantly affected by all treatments in the first and second seasons. Adding EM to the soil increased fruit weight in both seasons compared with untreated soil. In addition, yeast at 0.3% gave the highest fruit weight in both seasons. Furthermore, algae at 2% were the best fruit weight.

On the other hand, interaction between yeast at 0.3% using EM gave the highest fruit weight. However, interaction between algae 2% using EM resulted in the best fruit weight in both seasons. Furthermore, interaction between alga at 2% and yeast at 0.3% gave the highest value of fruit weight in both seasons.

Regarding interaction between algae at 2% and yeast at 0.3% using EM gave the best fruit weight in both seasons. On the other hand, control without EM gave the lowest fruit weight.

**Fruit volume:**

Results in Table (16) showed that fruit volume was significantly affected by treatments in both studied seasons. Added EM to the soil increased fruit volume (316.15 and 334.31 in both seasons, respectively) compared with untreated soil. In addition, yeast at 0.3% gave the highest fruit volume (308.06 and 324.28 in both seasons respectively). Furthermore, an alga at 2% was the best fruit volume (311.06 in first season and 326.22 in second season).

Moreover, Interaction between yeast at 0.3% with adding EM gave the highest fruit volume in both seasons. On the other hand, Interaction between algae at 2% using EM was better to increase fruit volume than control in the two seasons without any significant differences between algae application at 1% or 2% in the second season only. In addition, interaction between algae at 2% and yeast at 0.3% gave higher value of fruit volume (327.00 and 341.12) compared with control (221.67 and 251.83) in first and second seasons, respectively.

**Table 15:** Effect of EM, extract of yeast, algae and interaction on fruit weight of Sukkary mango during 2012 and 2013 seasons

fruit weight (g)																	
A- Specific effect of EM, extract of yeast and algae																	
EM				Extract of yeast						Extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013			
without	with	without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%		
272.70 B	326.67 A	295.00 B	342.22 A	278.17 C	304.83 B	316.06 A	300.72 C	323.17 B	331.94 A	265.67 C	312.78 B	320.61 A	290.22 C	330.28 B	335.33 A		
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae				D-Interaction between extract of yeast and algae									
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	without	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	256.67 F	299.67 C	280.44 F	321.00 C	Cont.	243.78 E	287.56 CD	270.78 E	309.6 7C	Cont.	229.0 0H	279.1 7G	288.8 3F	258.0 0G	302.3 3F	310.3 3E	
0.2%	274.78 E	334.89 B	297.11 E	349.22 B	1%	283.56 D	342.00 B	304.44 D	356.1 1B	1%	299.0 0E	315.5 0C	323.8 3B	319.6 7D	332.3 3C	338.8 3B	
0.3%	286.67 D	345.44 A	307.44 D	356.44 A	2%	290.78 C	350.44 A	309.78 C	360.8 9A	2%	306.5 0D	319.8 3BC	335.5 0A	324.5 0D	334.8 3BC	346.6 7A	
E-Interactions between EM, extract of yeast and algae																	
seasons	2012								2013								
yeast	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		EM	without		with	
	without	with	without	with	without	with	without	with	without	with	without	with		without	with		
Cont.	222.33 m	235.67 l	247.33 k	311.00 fg	261.67 j	316.00 f	248.67 m	267.33 l	277.00 k	327.67 de	286.67 j	334.00 d	Cont.	217.67 l	225.67 l	241.67 k	300.33 fg
1%	269.97 ij	328.33 e	287.33 h	343.67 cd	293.67 h	354.00 b	294.00 ij	345.33 c	305.33 gh	359.33 b	314.00 f	363.67 b	1%	263.33 j	316.67 e	281.67 hi	337.00 bc
2%	278.00 i	335.00 de	289.67 h	350.00 bc	304.67 g	366.33 a	298.67 hi	350.33 c	309.00 fg	360.67 b	321.67 e	371.67 a	2%	273.33 i	327.00 d	281.33 hi	330.67 cd

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

**Table 16:** Effect of EM, extract of yeast, algae and interaction on fruit volume of Sukkary mango during 2012 and 2013 seasons

fruit volume (cm <sup>3</sup> )																	
A- Specific effect of EM, extract of yeast and algae																	
EM				Extract of yeast						Extract of algae							
2012		2013		2012		2013		2012		2013		2012		2013			
without	with	Without	with	Cont	0.2%	0.3%	Cont	0.2%	0.3%	Cont	1%	2%	Cont	1%	2%		
266.59 B	316.15 A	287.04 B	334.31 A	270.61 C	295.44 B	308.06 A	293.83 C	313.94 B	324.28 A	258.17 C	304.89 B	311.06 A	283.39 C	322.44 B	326.22 A		
B-Interaction between EM and extract of yeast				C-Interaction between EM and extract of algae				D-Interaction between extract of yeast and algae									
EM	2012		2013		EM	2012		2013		yeast	2012			2013			
	without	with	witho t	with		algae	without	with	without		with	Cont	0.2%	0.3%	Cont	0.2%	0.3%
Cont.	251.44 F	289.78 C	273.56 F	314.11 C	Cont.	238.78 E	277.56 D	264.11 D	302.67 B	Cont.	221.6 7H	271.0 0G	281.83 F	251.8 3G	295.3 3F	303.0 0E	
0.2%	268.22 E	322.67 B	288.44 E	339.44 B	1%	277.11 D	332.67 B	297.00 C	347.89 A	1%	290.0 0E	309.3 3C	315.33 B	312.3 3D	326.5 0B	328.5 0B	
0.3%	280.11 D	336.00 A	299.11 D	349.33 A	2%	283.89 C	338.22 A	300.00 CD	352.33 A	2%	300.1 7D	306.0 0C	327.00 A	317.3 3CD	320.0 0C	341.1 2A	
E-Interactions between EM, extract of yeast and algae																	
seasons	2012								2013								
yeast	Cont.		0.2%		0.3%		Cont.		0.2%		0.3%		EM	without		with	
	without	with	without	with	without	with	without	with	without	with	without	with		without	with		
Cont.	217.67 l	225.67 l	241.67 k	300.33 fg	257.00 j	306.67 f	244.00 n	259.67 m	269.33 l	321.33 ef	279.00 k	327.00 e	Cont.	217.67 l	225.67 l	241.67 k	300.33 fg
1%	263.33 j	316.67 e	281.67 hi	337.00 bc	286.33 h	344.33 b	286.67 j	338.00 d	301.00 gh	352.00 bc	303.33 g	353.67 b	1%	263.33 j	316.67 e	281.67 hi	337.00 bc
2%	273.33 i	327.00 d	281.33 hi	330.67 cd	297.00 g	357.00 a	290.00 ij	344.67 cd	295.00 hi	345.00 cd	315.00 f	367.33 a	2%	273.33 i	327.00 d	281.33 hi	330.67 cd

Means having the same letter (s) in each Column, row or interaction are not significantly different at 5% level

Furthermore, interaction between algae at 2% and yeast at 0.3% using EM gave the best fruit volume in both seasons. The previous results revealed that spraying algae extract at 2% + yeast at 0.3% using EM improved physical properties of mango fruits comparing with the other treatments. From the above results, it could be concluded that improved growth of the trees and the increased level of its mineral content is reflected on improving the physical properties of fruits and this may be due to the algae, yeasts and EM contents of various components such as growth regulators and vitamins and other components. These results are in agreement with those reported by (Abd-El-Messeih *et al.*, 2005) who suggested that adding EM to the soil increased fruit weight as compared with the untreated of Le Conte pear trees. In addition, Elham *et al.*, (2010) who recorded that spraying mango trees with algae at 2% combined with yeast at 0.2% increased fruit weight. In addition, these results are in harmony with those obtained by Gobara *et al.* (2002).

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