Effect of Yeast and Zinc Sulfate on Productivity, Fruit Quality and Leaf Minerals Content of Hayany Date Palm Under Salinity Stress at Ras – Sudr Conditions, Egypt

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Abstract: A field experiment was conducted during 2013 and 2014 seasons in a private orchard of "Hayany" date palm grown in sandy soil under drip irrigation system from a well at Ras-Sudr, South Sinai Governorate, Egypt. The main object is to study the effect of yeast and zinc sulphate as well as their combinations on leaf total chlorophyll content, leaf mineral content, fruit set percentage, retained fruit percentage, yield and fruit quality properties of "Hayany" date palm. The present study is a factorial experiment with two factors, the first factor consisted of 3 levels of yeast soil application (0, 5, and 10 g/palm/year) and the second factor involved of 3 levels of zinc sulfate soil application (0, 200 and 400 g/palm/year). The treatments were arranged in a randomized complete block design. However, soil application of yeast and zinc sulphate treatments were divided into three equal doses applied on February, 1st, May, 1st and July, 1st in each season. Results showed that yeast and/or zinc sulphate treatment alone or in combination enhanced leaf total chlorophyll content, leaf mineral content, fruit set percentage, retained fruit percentage, yield and fruit quality properties of "Hayany" date palm through alleviated the adverse effect of salinity.
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1. Introduction

Date palm (*Phoenix dactylifera* L) is the most important fruit species in Egypt. It is a commonly fruits in arid and semi arid region. Also, it plays an important role in the economic and social life of the people in Egypt. Hayany date palm cultivar is one of the most economically important soft date cultivars grown in Egypt and it is highly sensitive to salinity than "Sewy" and "Zaghloul" cultivars (El-Khawaga, 2013).

Salinity is an environmental stress, mainly occurs in arid and semi-arid conditions where rain precipitation is not enough to leach the excess soluble salts from the root zone, as well as, it can occur in irrigated agriculture cultivations particularly when water of poor quality is used for irrigation. Salinity induces osmotic stress, ionic imbalance, ion toxicity and nutrient deficiency regarding plant growth (Munns, 2002 and Parida and Das, 2005). Salinity stress is a major a biotic stress adversely reduced growth, fruit set and productivity of date palm (Ayers and Westcot, 1985 and Erskine et al., 2004).

Date palm can grow in different type of soils (Diallo, 2005). In addition, new reclaimed soils, where soil is sandy, poor in their nutrients and suffer from salinity, poverty of fertility and lower in catching water, leads to lower nutrient uptake by plant. So that, it has negative effect on vegetative growth, yield and fruit quality. Furthermore, many growers rely on date palm cultivation and they have mistakenly believed that date palm does not require much attention. Meanwhile, the successful horticultural practices are the way to high yield and good fruit quality. On the other hand, the use of fertilization as a horticultural practice to enhance tree growth and productivity through minimizing and counteract salinity affects on the tree.

Concerning the action effect of the tested treatments on date palm are somewhat rare thereupon, the review of literature in this concern are supported with other species rather than date palm.

Yeast (*Saccharomyces cervicisae*) is considered as a new promising biofertilizer for many crops. Yeast (natural stimulator) is characterized by its richness in protein and B vitamin group content (thiamin, riboflavin and pyridoxines). Also, yeast is prolific producer vitamins, amino acid, hormones and other growth regulating substances (Harrison, 1968). The positive effects of applying yeast could be due to yeast contains tryptophan which consider precursor of IAA, so it increases size of fruit (Moor, 1979). It was found that yeast has stimulatory effects on cell division and enlargement, synthesis of protein and nucleic acid as well as chlorophyll formation (Fathy and Farid, 1996). However, yeast aids in activating photosynthesis process through enhancing the release of carbon dioxide (Larson et al., 1962). In addition, it contains cytokinins and some important nutrients as N, P, K and some common amino acids (Abou-Zaid, 1984). In addition, application of active bread yeast on flame seedless grape vines was very effective in releasing CO_2, which reflected on improving net photosynthesis

(Hashem et al., 2008). Mostafa and Abou Raya (2003) recorded that, yeast as soil application improved growth parameters of "Grand Nain" banana cv. compared with control without yeast treatment. Furthermore, Gadalla et al. (2011) showed that yeast treatment improved yield and fruit quality of Hayany and Sewy date palm cultivars. Moreover, El-Sayed (2013) indicated that soil application of yeast at 10 g/tree and humic acid at 60 g/tree improved leaf area, total chlorophyll content, leaf mineral content, yield and fruit quality as well as alleviated salinity stress of "Aggizy" olive trees.

On the other hand, zinc is an essential metal for normal plant growth and development (Cakmak, 2000). It plays a fundamental role in many essential cellular functions such as protein metabolism and IAA (Marschner, 1995). It is well known that zinc is an important component of many vital enzymes, including ribulose-1, 5-bisphosphate carboxylase involved in photosynthesis, which catalyzes the initial step of carbon dioxide fixation in of photosynthesis (Brown et al., 1993). It stabilizes the structure of membrane proteins and DNA-binding proteins (Aravind and Prasad, 2004). Zinc plays a key role in N metabolism of plant and Zn deficient plants have reduced protein content (Mengel et al., 2001 and Hassan et al., 2010). On the other hand zinc could alleviate alterations of NaCl plants in areas affected by salt (Marschner and Cakmak, 1989 and Parker et al., 1992), which was confirmed by (Alpaslan et al., 1999). Furthermore, Aktas et al. (2006) indicated that adequate Zn nutrition reduces excess uptake of Na by roots in saline conditions. Moreover, adequate Zn nutrition is important for the maintenance of good growth and yield under saline conditions of pepper plants. However, Khoshgoftarmanesh et al. (2001) found that using zinc sulfate increases plant tolerance to salinity in wheat and enhanced yield and improve grain quality under salinity stress. Moreover, zinc plays an important role in achieving a satisfactory fruit set and retention and improved yield as well as fruit quality of "Shahany" date palm (Khayyat et al., 2007). Moreover, Zhang et al. (2014) reported that soil application of B and Zn improved number of fruit per tree, yield and fruit quality of Satsuma mandarin.

This investigation aimed to study the effect of the yeast at 5 and 10 g/palm/year and zinc sulphate at 200 and 400 g/palm/year as well as their combinations on leaf total chlorophyll content, fruit set percentage, retained fruit percentage, yield, fruit quality properties and leaf mineral content of "Hayany" date palm under Ras-sudr conditions, Egypt, through alleviating the adverse effect of salinity.

2. Material and Methods

This study was carried out during two successive seasons of 2013 and 2014 in a private orchard, at Ras-Sudr, South Sinai Governorate, Egypt on "Hayany" date palm of nine years old grown in sandy soil, spaced 7x7m apart and subjected to drip irrigation system from a well. Physical and chemical analyses of the experimental soil are shown in Table 1. Meanwhile, the chemical analysis of the used water for irrigation is recorded in Table 2. The trees were irrigated according the recommended program including the rate and the schedule as followed in the district of Ras-Sudr, South Sinai Governorate. The amount of applied water was 5216.3 m^3 /ha / season. Moreover, annual rainfall was 7.8 mm in 2013 season and 9.1 mm in 2014.

The ordinary fertilization program used in this district was 25kg/palm of sheep manure added in December, 1.5 kg/palm of triple calcium super phosphate (45 % P_2O_5) broadcasted on the soil surface through the whole area during December and 5 kg ammonium sulphate/palm (20.5%N) divided into three equal doses applied on February, 1st, May, 1st and July, 1st. broadcasted on the soil surface through the whole area.

Fifty four female palms healthy, nearly uniform in shape, size and productivity, received the same horticultural practices were treated with yeast as biofertilizer and zinc sulphate ($Zn_2SO_4.H_2O$ 36%) fertilizer as soil application.

The present study was designed as in a factorial experiment with two factors i.e. the first factor consists of 3 levels of yeast soil application (0, 5, and 10 g/palm/year) and the second factor consist of 3 levels of zinc sulfate soil applications (0, 200 and 400 g/palm/year). Table 3 shows the chemical analysis of yeast extract according to El-kafrawi (2005). The treatments were arranged in a randomized complete block design with three replicates for each treatment and each replicate was represented by two palms.

Active dry yeast (*Saccharomyces cerevisiae*) solution was prepared through dissolving yeast in one liter of water followed by adding molasses at ratio 1:1 and kept for activation and reproduction of yeast according to Sommer (1996).

Soil application of zinc sulphate treatments and yeast were divided into three equal doses applied on February, 1st, May, 1st and July, 1st in each season.

Table 1. Analysis of experimental soil of a private orchard, at Ras-Sudr, South Sinai Governorate, Egypt.

Soil depth (cm)	Texture class	pH soil past	E.C (dSm^{-1})	Organic matter %	Soluble cations (mequiv./l)				Soluble anions (mequiv./l)			
					Ca^{++}	K^+	Na^+	Mg^{++}	Cl^-	$So_4^=$	HCo_3^-	$Co_3^=$
0-30	Sand	7.28	9.1	0.53	13.2	1.3	52.3	22.3	53.5	33.1	2.5	--
30-60	Sand	7.16	8.6	0.55	15.3	1.1	47.7	20.9	51.5	32.1	2.4	--

Table 2. Chemical analysis of water used for irrigation at of a private orchard, at Ras-Sudr city, South Sinai Governorate, Egypt.

PH	E.C (dSm^{-1})	Soluble cations (me/l)				soluble anions (me/l)			
		Ca^{++}	Mg^{++}	Na_+	K^+	$Co_3^{=}$	HCo_3^{-}	Cl^{-}	$So_4^{=}$
7.43	8.1	14.4	20.6	44.9	1.16	--	2.3	48.5	30.2

Table 3. Chemical analysis of yeast extract.

Macro elements (g/100g dry wt.)		**Micro elements (mg/100g dry wt.)**		**Amino acids (mg/100g fresh wt.)**		**Vitamins (mg/100g fresh wt.)**	
Total N	6.20	Al	198	Arginine	1.91	Riboflavin (B2)	4.15
P_2O_5	45.65	Ba	101	Histidine	1.64	Nicotinic acid	24.98
K_2O	24.36	Co	46	Leucine	2.05	Panthothenic acid	13.52
NaO	0.33	Pb	235	Isoleucine	1.32	Biotin (H)	0.09
MgO	3.72	Mn	59	Lysine	1.92	Folic acid	6.11
CaO	2.02	Sn	121	Methionine	0.75	Thiamine (B1)	2.33
SiO_2	1.51	Zn	231	Phenylanine	1.00	Pyridoxine (B6)	3.92
SO_2	0.44			Threonine	1.09	Vitamin (B12) (mg/100g)	4.14
Cl	0.05			Tryptophan	0.43	Inositol (mg/100g)	1.51
FeO	0.90			Valine	1.19		
NaCl	0.28			Glutamic acid	0.95		
				Serine acid	1.31		
				Cystine	0.20		
				Proline	1.52		
				Tyrosine			
Total carbohydrates (g/100g dry wt.)				**Enzymes (mg/100g fresh wt.)**			
Carbohydrates		13.00		Cytochrome oxidase		0.33	
Glucose		11.21		Cytochrome Peroxidase		0.28	

The response of "Hayany" date palms to yeast, zinc sulfate (Zn_2SO_4) and their combinations were evaluated through the following determinations.

2.1. Leaf total chlorophyll content

Leaf total chlorophyll content was determined by Minolta chlorophyll meter SPAD-502.

2.2. Leaf mineral content

To determine leaf mineral content (N, P, K, Ca, Mg, Fe, Mn, Zn and Cu), leaf samples were taken during November and washed with tap water then with distilled water to remove any dust. After washing, leaves were dried in an electric oven at 70ºc for 72 hours. The dried leaves were ground, digested and prepared for analysis using the method described by Parkinson and Allen (1975). Total nitrogen was determined by the semi-micro kjeldahl method (Bremner 1965). Phosphorus was estimated by the method of Chapman and Pratt (1961). Potassium was determined by the flame-photometer according to Jackson (1958). Calcium and magnesium were determined by titration against versente solution (Na EDTA) according to Chapman and Pratt (1961). Iron, Manganese and zinc were determined by using the Atomic Absorption Spectophotometer "GBC 932 AA".

2.3. Fruit set percentage

Number of nodes and set fruits in twenty five strands per palm were recorded after 4 weeks of pollination. The percentage of fruit set was calculated using the following formula:

The percentage of fruit set = {(Total number of set fruit per strand) / (Total number of nods per strand)} ×100

2.4. Retained fruit percentage

The retained fruit percentage was calculated at the harvest time on September, 1st according to Soliman and El Kosary (2002) formula as follows:

The retained fruit percentage = {(Total number of retained fruits per bunch)/ (Total number of the nodes per bunch)} ×100

2.5. Yield kg/palm

In both seasons, dates were harvested at the first of September when fruits reached "Khalal" stage and the average fruit yield and bunch weight was recorded in Kilograms.

2.6. Fruit physical and chemical properties

Forty fruits were taken at harvest from each treated palm at "Khalal" stage (full mature, crunchy and red in color) from each bunch to determine the following physical and chemical properties i. e. fruit weight (g), fruit volume (cm3), fruit length (cm), fruit diameter (cm), pulp weight (g), pulp dry matter (%), seed weight (g), total soluble solids content (T.S.S.) which was determined by hand refractometer, percentage of total acidity as g citric acid / 100 g F.Wt., T.S.S./Acid ratio and total sugars (%) g/100g f.wt., which were determined according to A.O.A.C. (1995).

Statistical analysis

The obtained data in 2013 and 2014 seasons were subjected to analysis of variance according to Clarke and Kempson (1997) using MSTAT-C program version 7 (1990). Means were differentiated using multiple Range test at the 0.05 level (Duncan, 1955).

3. Results

3.1. Leaf total chlorophyll content

Table 4, indicates that under salt stress yeast soil applications induced high positive effect on leaf total chlorophyll content as compared with the control in both seasons of study.

Generally, 10 g yeast/palm treatment proved to be the superior treatment in this concern.

Moreover, soil applications of zinc sulfate increased leaf total chlorophyll content as compared with the control in both seasons of study.Shortly, 400 g zinc sulfate/palm treatment showed superiority in this concern.

However, the interaction between the two tested factors showed that yeast combined with zinc sulfate enhanced leaf total chlorophyll content as compared with the control in both seasons of study. Briefly, 10 g yeast/palm combined with 400 g zinc sulfate/palm treatment proved to be the superior treatment in this respect. Other combinations showed an intermediate values in this respect.

3.2. Leaf mineral content.

3.2.1. Nitrogen (%)

Table 5, indicates that under salinity stress yeast treatments gave high positive effect on leaf nitrogen content as compared with control treatment in both seasons of study. Generally, 10 g yeast/palm treatment proved surpassed other treatments in this respect

Moreover, zinc sulfate treatment produced positive effect on leaf nitrogen content as compared with control in both seasons. Shortly, 400 g zinc sulfate/palm treatment showed to be the superior treatment in this respect

The interaction between the two tested factors illustrated that yeast treatments combined with zinc sulfate treatments succeeded in increasing leaf nitrogen content as compared with control treatment in both seasons. Generally, 10 g/palm yeast combined with 400 g zinc sulfate/palm treatment surpassed other combinations in both seasons. Other treatments showed an intermediate values in this respect.

Table 4. Effect of yeast, zinc sulfate soil application and their interaction on leaf total chlorophyll content of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Total chlorophyll							
	2013				2014			
	Zinc sulfate g /palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**
0	54.50 i	58.93 g	60.90 e	**58.1 C**	57.50 g	62.86 f	64.20 e	**61.52 C**
5	57.83 h	63.63 d	66.83 c	**62.76 B**	63.26 f	68.36 d	73.10 b	**68.24 B**
10	59.90 f	67.70 b	60.50 a	**62.70 A**	64.36 e	70.76 c	77.03 a	**70.72 A**
Mean	**57.41 C**	**63.42 B**	**62.74 A**		**61.71 C**	**67.33 B**	**71.44 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 5. Effect of yeast, zinc sulfate soil application and their interaction on leaf nitrogen and phosphorus content of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	N (%)								P (%)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	1.23 d	1.30 d	1.40 c	**1.31 C**	1.20 e	1.30 de	1.63 b	**1.37 B**	0.24 c	0.37 ab	0.38 ab	**0.33 B**	0.23 d	0.37 b	0.39 b	**0.33 B**
5	1.30 d	1.40 c	1.46 c	**1.38 B**	1.26 e	1.40 cd	1.50 c	**1.38 B**	0.28 bc	0.42 a	0.48 a	**0.39 AB**	0.31 c	0.40 b	0.42 b	**0.38 A**
10	1.30 d	1.66 b	1.76 a	**1.57 A**	1.26 e	1.50 c	1.86 a	**1.54 A**	0.27 bc	0.48 a	0.49 a	**0.41 A**	0.31 c	0.42 b	0.49 a	**0.41 A**
Mean	**1.27 C**	**1.45 B**	**1.54 A**		**1.24 C**	**1.40 B**	**1.66 A**		**0.26 B**	**0.42 A**	**0.45 A**		**0.28 C**	**0.40 B**	**0.43 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

3.2.2. Phosphorus (%)

Table 5, indicates that yeast treatments produced similar and higher positive effect on leaf phosphorus content of "Hayany" date palm as compared with the control treatment in both seasons of study. Briefly, yeast treatment at 10 g/palm in the first season and at 5 and 10 g/palm in the second season showed superiority in this concern.

Moreover, 200 and 400 g zinc sulfate/palm treatments gave a similar and high positive effect on leaf phosphorus content of "Hayany" date palm as compared with the control treatment in first season of study. Moreover, 400 g zinc sulfate/palm treatment gave high positive effect on leaf phosphorus content compared with the control treatment in second season.

On the other hand, the interaction between the two tested factors produced a pronounced positive effect on leaf phosphorus content as compared with control in both seasons of study. Generally, 5 and/or 10 g yeast per palm combined with 200 and/or 400 g zinc sulfate per palm surpassed other treatments in first season. Briefly, 10 g yeast per palm combined with zinc sulfate treatment at 400 g/palm proved to be the superior treatment in second season in this respect.

3.2.3. Potassium (%)

Table 6, demonstrates that under salinity stress yeast treatments increased on leaf potassium content as compared with control treatment in both seasons. However, 10 g yeast/palm treatment surpassed other treatment in enhancing leaf potassium content in both seasons

Moreover, zinc sulfate treatment enhanced leaf potassium content as compared with control in both seasons. Generally, 400 g zinc sulfate/palm treatment showed to be the most effective treatment in this respect

Furthermore, the interaction between the two tested factors produced higher leaf potassium content as compared with control in both seasons. Shortly, 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment proved to be the superior treatment in this concern.

3.2.4. Magnesium (%)

Table 6, reveals that yeast treatments gave high positive effect on leaf magnesium content as compared with control treatment in both seasons of study. Generally, 10 g yeast/palm treatment proved to be the superior treatment in this respect

Moreover, zinc sulfate treatment increased leaf magnesium content as compared with control in both seasons. In general, 400 g zinc sulfate/palm treatment showed to be the most effective treatment in this respect

The interaction between the two tested factors demonstrated that yeast combined with zinc sulfate treatments succeeded in increasing leaf magnesium content as compared with control treatment in both seasons. Generally, 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment surpassed other combinations in this concern in both seasons of study. Other treatments scored an intermediate values in this respect.

3.2.5. Iron (ppm)

Table 7, demonstrates that yeast treatments gave high positive effect on leaf iron content as compared with control treatment in both seasons. Generally, yeast treatment at 10 g/palm proved to be the superior treatment in this concern.

Moreover, zinc sulfate treatment increased leaf iron content as compared with control in both seasons. Shortly, 400 g zinc sulfate/palm treatment proved to be the superior treatment in this respect.

The interaction between the two tested factors illustrated that yeast treatments combined with zinc sulfate treatments succeeded in increasing leaf iron content as compared with control treatment in both seasons. Generally, yeast treatment at 10 g/palm combined with zinc sulfate treatment at 400 g/palm showed to be the most effective combinations in both seasons. Other treatments showed an intermediate values in this sphere.

3.2.6. Manganese (ppm)

Table 7, indicates yeast treatments increased leaf manganese content as compared with control treatment in both seasons. Generally, 10 g yeast/palm treatment proved to be the superior treatment in this concern.

Moreover, zinc sulfate treatment enhanced leaf manganese content as compared with control in both seasons. However, 400 g/palm zinc sulfate treatment proved to be the superior treatment in this respect.

The interaction between two factors shows that yeast combined with zinc sulfate treatments succeeded in increasing leaf manganese content as compared with control treatment in both seasons. Generally, 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment surpassed other combination in this sphere in both seasons.

Table 6. Effect of yeast, zinc sulfate soil application and their interaction on leaf potassium and magnesium content of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	K (%)								Mg (%)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g /palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	0.45 g	0.49 de	0.50 d	**0.48 C**	0.45 f	0.49 e	0.49 e	**0.48 C**	0.23 e	0.34 cd	0.35 cd	**0.31 C**	0.23 e	0.37 c	0.37 c	**0.32 C**
5	0.46 fg	0.54 c	0.56 b	**0.51 B**	0.48 e	0.53 d	0.55 c	**0.52 B**	0.30 d	0.38 bc	0.39 abc	**0.36 B**	0.29 d	0.38 c	0.38 c	**0.35 B**
10	0.48 ef	0.57 b	0.60 a	**0.55 A**	0.48 e	0.59 b	0.61 a	**0.56 A**	0.31 d	0.42 ab	0.45 a	**0.39 A**	0.30 d	0.42 b	0.45 a	**0.39 A**
Mean	**0.46 C**	**0.53 B**	**0.55 A**		**0.47 C**	**0.53 B**	**0.55 A**		**0.28 B**	**0.38 A**	**0.40 A**		**0.27 C**	**0.39 B**	**0.40 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 7. Effect of yeast, zinc sulfate soil application and their interaction on leaf iron and manganese content of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Fe (ppm)								Mn (ppm)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	42.66 f	48.10 de	50.96cde	**47.24 C**	45.00 f	48.00 e	51.43 d	**48.14 C**	25.50 e	28.03 bcd	28.76 bc	**27.43 B**	26.96 d	28.16 cd	29.50bc	**28.21 B**
5	46.46 ef	52.46 bcd	54.16 bc	**51.03 B**	45.53 ef	53.23 cd	55.80 bc	**51.52 B**	26.86 de	28.40 bcd	29.53 b	**28.26 B**	27.20 d	30.40 b	29.96 b	**29.18 B**
10	46.60 ef	56.43 ab	60.56 a	**54.53 A**	46.26 ef	56.36 b	60.33 a	**54.32 A**	27.56 cd	29.80 b	32.43 a	**29.93 A**	26.76 d	30.36 b	32.73 a	**29.95 A**
Mean	**45.24 C**	**52.33 B**	**55.23 A**		**45.60 C**	**52.53 B**	**55.85 A**		**26.64 C**	**28.74 B**	**30.24 A**		**26.97 C**	**29.64 B**	**30.73 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

3.2.7. Zinc (ppm)

Table 8, illustrates that under salinity stress yeast treatments increased leaf zinc content as compared with control in first season. Generally, 5, 10 g yeast per palm treatment in the first season and yeast treatment at 10 g/palm in the second season showed to be the best treatment in this concern.

Moreover, zinc sulfate treatment improved leaf zinc content as compared with control in both seasons.

In general, zinc sulfate treatment at 400 g/palm in the first season and two levels of zinc sulfate treatments in the second season proved to be the superior treatment in this respect.

The interaction between the two tested factors indicated that yeast combined with zinc sulfate treatments succeeded in increasing leaf zinc content in both seasons. Shortly, 10 g yeast/palm treatment combined with 400 g zinc sulfate treatment proved to be the most efficient treatments in this concern.

3.3. Fruit set (%)

Table 9, illustrates that yeast treatments at 5 and 10 g/palm induced a similar and high positive effect on fruit set percentage of "Hayany" date palms from the statistical standpoint as compared with the control in second season of study.

However, zinc sulfate treatments at 200 and 400 g/palm exerted statistically similar and high positive effect on fruit set percentage as compared with the control in second season of study.

Moreover, the interaction between yeast and zinc sulfate treatments demonstrated that 5 and /or 10 g yeast/palm treatment combined with 200 and/or 400 g zinc sulfate/palm treatment gave a similar and high positive effect on fruit set percentage as compared with the control in second season of study. Other combinations gave an intermediate values in this respect.

3.4. Retained fruit (%)

Table 10, reveals that yeast treatments exerted high enhancing effect on retained fruit percentage as compared with the control treatment in both seasons of study. Generally, yeast treatment at high level scored the highest values in this concern.

Moreover, zinc sulfate treatments gave higher positive effect on retained fruit percentage as compared with the control treatment in both seasons of study.

Generally, 400 g zinc sulfate/palm treatment showed to be the most effective treatment in this concern

However, the interaction between yeast and zinc sulfate treatments showed that10 g yeast/palm combined with 400 g zinc sulfate/palm surpassed other tested combinations in this respect. Other combinations scored an intermediate values in this respect.

3.5. Yield

3.5.1. Yield (kg)/tree

Table 10, illustrates that under salinity stress soil applications of yeast succeeded in improving palm yield as compared with the control in both seasons. Generally, 10 g yeast/palm treatment scored 64.51 and 64.24 kg/palm as compared with 53.75 and 54.88 kg/palm for control treatment in both seasons, respectively.

Moreover, zinc sulfate treatments enhanced of yield "Hayany" date palms productivity as compared with the control in both seasons of study. Shortly, 400 g zinc sulfate/palm treatment scored 65.23 and 64.26 kg/palm against 51.74 and 52.92 kg/palm for control treatment in both seasons, respectively.

However, the interaction between yeast and zinc sulfate treatments induced high positive effect on the highest palm yield as compared with control in both seasons. Briefly, in the first season combinations of 10 g yeast/palm treatment plus 200 and/or 400 g zinc sulfate/palm treatment surpassed other treatments in improving palm yield. Also, in the second season combinations of 5 and 10 g yeast/palm treatment plus 200 and 400 g zinc sulfate/palm treatment exerted statistically similar and high Positive effect on palm yield and surpassed other tested combinations.

3.5.2. Bunch weight (kg)

Table 11, demonstrates yeast treatments increased bunch weight as compared with control treatment in both seasons. However, 10 g/palm yeast treatment shows superiority in this respect.

Moreover, zinc sulfate treatments exerted higher positive on bunch weight as compared with control in both seasons. Generally, 400 g zinc sulfate treatment in the first season and 200, 400 g zinc sulfate/palm treatments in the second one showed to be the superiority in this respect.

Moreover, the interaction between yeast and zinc sulfate treatments shows that in the first season 5 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment improved bunch weight and surpassed other combinations in this respect. Furthermore, in the second season 5 and/or 10 g yeast/palm treatments combined with 200 and/or 400 g zinc sulfate produced a similar and high positive effect on palm bunch weight in this concern. Other treatments showed an intermediate values in this respect.

3.6. Fruit physical and chemical properties

3.6.1. Fruit weight (g)

Table 11, shows that 5 and 10 g yeast/palm treatments produced statistically similar and higher positive effect on fruit weight as compared with the control treatment in first season of study. However, 10 g yeast/palm treatment scored 11.6 and 12.6 g against

10.2 and 10.3 g for control treatment in both seasons respectively.

Moreover, 200 and 400 g zinc sulfate/palm treatments gave similar and high values of fruit weight as compared with the control treatment in both seasons of study.

Furthermore, the interaction between yeast and zinc sulfate treatments showed that in the first season 10 g yeast/palm treatment combined 400 g zinc sulfate/palm treatment scored the highest values in this concern. However, in the second season 5 g yeast /palm treatment combined 400 g zinc sulfate/palm treatment also 10 g yeast/palm treatment combined 200 and/or 400 g zinc sulfate/palm treatments surpassed other combinations in this sphere.

Table 8. Effect of yeast, zinc sulfate soil application and their interaction on leaf zinc content of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Zn (ppm)							
	2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**
0	28.70 f	31.26 cde	32.26 bcd	**30.74 B**	29.50 f	30.70 ef	31.50 de	**30.56 C**
5	30.80 def	31.56 cde	33.80 b	**32.05 A**	29.43 f	33.50 bc	32.63 cd	**31.85 B**
10	29.60 ef	33.30 bc	35.96 a	**32.95 A**	30.63 ef	33.93 b	35.70 a	**33.42 A**
Mean	**29.70 C**	**32.04 B**	**34.01 A**		**29.85 B**	**32.71 A**	**33.27 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 9. Effect of yeast, zinc sulfate soil application and their interaction on fruit set percentage of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Fruit set (%)							
	2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**
0	79.70 a	79.80 a	80.56 a	**80.12 A**	79.03 d	81.46 b	81.60 b	**80.70 B**
5	80.07 a	80.70 a	80.37 a	**80.37 A**	80.36 c	82.46 a	82.50 a	**81.77 A**
10	80.70 a	81.07 a	81.70 a	**80.82 A**	80.63 c	82.56 a	82.56 a	**81.92 A**
Mean	**80.16 A**	**80.52 A**	**80.64 A**		**80.01 B**	**82.16 A**	**82.22 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 10. Effect of yeast, zinc sulfate soil application and their interaction on fruit retained percentage and yield of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Fruit retained (%)								Yield (kg)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	29.57 h	31.56 g	32.40 f	**31.17 C**	30.04 f	31.40 e	32.18 d	**31.21 C**	47.60 e	53.13 de	60.53 bc	**53.75C**	50.16 d	55.66 bc	58.83 b	**54.88 C**
5	32.50 f	33.13 d	34.93 c	**33.52 B**	31.86 de	34.14 c	34.82 b	**33.60 B**	51.30 de	63.20 ab	65.50 ab	**60.00 B**	50.93cd	64.60 a	66.20 a	**60.57 B**
10	32.78 e	35.84 b	36.17 a	**34.93 A**	32.31 d	35.36ab	35.86 a	**34.50 A**	56.33 cd	67.53 a	69.66 a	**64.51A**	57.66 b	67.30 a	67.76 a	**64.24 A**
Mean	**31.62 C**	**33.51 B**	**34.50 A**		**31.40 C**	**33.63 B**	**34.28 A**		**51.74 C**	**61.28 B**	**65.23 A**		**52.92 B**	**62.52 A**	**64.26 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 11. Effect of yeast, zinc sulfate soil application and their interaction on bunch weight and fruit weight of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Bunch weight (kg)								Fruit weight (g)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	15.86 f	17.70 ef	20.16 cd	**17.91C**	16.70 d	18.53bc	19.60 b	**18.27 C**	9.2 d	10.7 c	10.9 bc	**10.2 B**	9.3 c	10.9 b	10.8 b	**10.3C**
5	17.00 ef	21.06 bc	21.83abc	**20.00 B**	16.96 cd	21.53 a	22.06 a	**20.18 B**	10.6 c	11.2 abc	11.6 abc	**11.1 A**	10.9 b	11.0 b	12.5 a	**11.4 B**
10	18.76 de	22.53 de	23.23 a	**21.51A**	19.20 b	22.46 a	22.56 a	**21.41 A**	10.6 c	12.0 ab	12.4 a	**11.6 A**	10.9 b	13.4 a	13.6 a	**12.6A**
Mean	**17.24 C**	**20.43 B**	**21.74 A**		**17.62 B**	**20.84 A**	**21.41 A**		**10.1 B**	**11.3 A**	**11.6 A**		**10.4 B**	**11.8 A**	**12.3 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

3.6.2. Fruit volume (cm^3)

Table 12, demonstrates that yeast treatments extract high positive effect on fruit volume as compared with control in both seasons. In general, 10 g yeast/palm treatment was most effective treatment in this respect.

Moreover, 200 and 400 g zinc sulfate/palm treatment gave statistically similar and high value of fruit volume as compared with the control in the first season. While, zinc sulfate treatments failed to induce any significant effect on fruit volume in the second season.

Furthermore, the interaction between yeast and zinc sulfate treatments gave a similar and high value of fruit volume. Generally, 10 g yeast/palm treatment combined 400 g zinc sulfate/palm treatments surpassed other combination in this concern.

3.6.3. Fruit length (cm)

Table 12, illustrates that yeast treatments significantly increased fruit length as compared with control in both seasons. However, 10 g yeast/palm treatment produced the longest dates.

Moreover, zinc sulfate treatments enhanced fruit length as compared with control in both seasons. Generally, 400 g zinc sulfate/palm treatments proved to be the most effective treatment in this concern.

Furthermore, the interaction between yeast and zinc sulfate treatments shows that 10 g yeast/palm treatment combined 400 g zinc sulfate/palm treatment produced the highest values of fruit length and surpassed other combinations in this sphere. Other treated treatments scored more or less an intermediate values in this concern.

3.6.4. Fruit diameter (cm)

Table 13, demonstrates the yeast treatments increased fruit diameter as compared with control treatment in both seasons. Generally, 10 g yeast/palm treatment showed superiority in this respect.

Moreover, 200 and 400 g zinc sulfate/palm treatments induced a similar and high positive effect on fruit diameter as compared with control treatments in first season and 400 g zinc sulfate/palm treatment in the second one and surpassed other treatments in this respect.

The interaction between the two tested factors showed that combination of 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment surpassed other tested combinations in this respect.

3.6.5. Pulp weight (g)

Table 13, reveals that the tested yeast treatments exerted higher positive on pulp weight as compared with control in both seasons. Shortly, 10 g yeast/palm treatment scored higher values in this respect.

Moreover, zinc sulfate treatments failed to induce any positive effect on pulp weight in the first season of study. While in the second season 400 g zinc sulfate/palm treatment gave the highest values in this concern.

The interaction between yeast and zinc sulfate illustrated that 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm gave high positive effect on pulp weight and surpassed other combinations in this respect.

3.6.6. Pulp dry matter (%)

Table 14, indicates that yeast treatment exerted positive effect on pulp dry matter percentage as compared with control in both seasons. Generally, 10 g yeast/palm treatment proved to be the superior treatment in this concern.

However, 200 and 400 g zinc sulfate/palm treatment exerted a similar and high positive effect on pulp dry matter percentage as compared with the control in first season of study. While in the second season 400 g zinc sulfate/palm treatment scored the highest values.

Moreover, the interaction between yeast and zinc sulfate treatments shows that 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment gave high positive effect pulp dry matter percentage as compared with the control in both seasons of study and surpassed other combinations.

3.6.7. Seed weight (g)

Table 14, indicates that yeast treatments failed to induce any positive effect on seed weight in both seasons of study.

However, 200 and 400 g zinc sulfate/palm exerted statistically similar and high positive effect on seed weight as compared with the control in first season of study. Meanwhile, in the second season 400 g zinc sulfate/palm treatment proved to be the superior treatment in this respect.

The interaction between the two tested factors showed that yeast combination with zinc sulfate induced a similar and high positive effect on seed weight as compared with control in the first season.

Briefly, combination of 10 g yeast/palm treatment combined 400 g zinc sulfate/palm treatment surpassed other treatments in the first season. While all combinations failed to induce any positive effect on seed weight in the second one.

3.6.8. Fruit T.S.S. (%)

Table 15, indicates that yeast soil application gave high positive effect on TSS as compared with control treatment in both seasons. Generally, 10 g yeast/palm treatment proved to be the superior treatment in this respect.

Table 12. Effect of yeast, zinc sulfate soil application and their interaction on fruit volume and fruit length of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Fruit volume (cm)								Fruit length (cm)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	9.56 d	11.13 c	11.26 bc	**10.65C**	10.66 b	11.06ab	11.76 ab	**11.16 B**	3.36 c	3.53 c	4.00 b	**3.63 C**	3.46 d	3.66 cd	3.86 bc	**3.66 B**
5	10.83 c	11.63 bc	12.00abc	**11.48 B**	11.76 ab	11.80ab	12.50 ab	**12.13 AB**	3.53 c	4.03 b	4.00 b	**3.85 B**	3.53 cd	3.90 bc	4.16 ab	**3.86 B**
10	11.06 c	12.50 ab	13.03 a	**12.20A**	11.83 ab	12.43ab	13.13 a	**12.46 A**	3.63 c	4.10 ab	4.40 a	**4.04 A**	3.66 cd	4.18 ab	4.36 a	**4.07 A**
Mean	**10.48 B**	**11.75 A**	**12.10 A**		**11.41 A**	**11.76 A**	**12.46 A**		**3.51 C**	**3.88 B**	**4.13 A**		**3.55 C**	**3.91 B**	**4.13 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 13. Effect of yeast, zinc sulfate soil application and their interaction on fruit diameter and pulp weight of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Fruit diameter (cm)								Pulp weight (g)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	1.80 c	2.13 b	2.36 ab	**2.10 B**	1.76 d	2.23 bc	2.33 bc	**2.11 B**	8.53 b	8.86 ab	9.03 ab	**8.81 B**	7.90 d	9.23 cd	9.10 cd	**8.74 C**
5	2.13 b	2.33 b	2.23 b	**2.23 B**	2.33 bc	2.16 c	2.33 bc	**2.24 B**	9.30 ab	9.40 ab	9.93 ab	**9.54 AB**	9.50 cd	9.23 cd	10.60 abc	**9.77 B**
10	2.20 b	2.33 b	2.60 a	**2.37 A**	2.20 c	2.50 ab	2.70 a	**2.46 A**	9.43 ab	9.80 ab	10.56 a	**9.93 A**	9.66 bc	11.26 ab	11.76 a	**10.90 A**
	2.04 B	**2.26 A**	**2.40 A**		**2.06 C**	**2.30 B**	**2.45 A**		**9.08 A**	**9.35 A**	**9.84 A**		**9.02 B**	**9.91 AB**	**10.48 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 14. Effect of yeast, zinc sulfate soil application and their interaction on pulp dry matter percentage and seed weight of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	Pulp dry matter (%)								Seed weight (g)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	35.86 e	36.53 de	37.96 bcd	**36.78 C**	36.86 b	36.80 b	37.43 b	**37.03 B**	1.4 b	1.5 ab	1.7 ab	**1.5 A**	1.4 a	1.7 a	1.7 a	**1.6 A**
5	36.93 cde	38.33 abc	38.40 abc	**37.88 B**	36.43 b	37.90 ab	38.90 ab	**37.74 AB**	1.6 ab	1.6 ab	1.7 ab	**1.6 A**	1.7 a	1.8 a	1.9 a	**1.8 A**
10	37.46 bcde	39.10 ab	39.93 a	**38.83 A**	37.10 b	38.80 ab	40.03 a	**38.64 A**	1.5 ab	1.7 ab	1.8 a	**1.6 A**	1.7 a	1.8 a	1.9 a	**1.8 A**
Mean	**36.75 B**	**37.98 A**	**38.76 A**		**36.80 B**	**37.83 AB**	**38.78 A**		**1.5 B**	**1.6 AB**	**1.7 A**		**1.6 A**	**1.7 A**	**1.8 A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Moreover, 400 g zinc sulfate/palm treatment induced high positive effect on TSS as compared with control in the first season. While, 200 and 400 g zinc sulfate/palm treatments gave a similar and high positive effect on TSS as compared with control in second season.

However, the interaction between the two tested factors showed that yeast combined with zinc sulfate soli applications succeeded in increasing TSS as compared with control treatment in both seasons. Generally, 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment surpassed other combinations in first seasons. However, 10 g yeast/palm treatment combined with 200 and 400 g zinc sulfate/palm treatments gave statically similar and the highest values in second seasons.

3.6.9. Fruit Total acidity content (%)

Table 15, illustrates that yeast treatments exerted high reductive effect on acidity as compared with control in both seasons. Shortly, 10g yeast/palm treatment surpassed other treatments in reducing acidity in both seasons.

Moreover, 400 g zinc sulfate/ palm treatment gave induced high reductive effect on acidity as compared with control in first seasons. While, 200 and 400 g zinc sulfate/palm treatments exerted a similar and high reduction in acidity as compared with control in second seasons.

However, the interaction between the two tested factors showed that yeast combined with zinc sulfate soli applications induced high reductive effect on acidity as compared with control in both seasons. Generally, 10 g yeast/palm treatment combined with 200 and 400 g zinc sulfate/palm exerted similar and high reductive effect on acidity and surpassed other combinations reduced acidity in both seasons.

3.6.10. Fruit T.S.S. / Acid ratio

Table 16, shows that yeast treatments produced a pronounced effect on TSS/acidity of Hayany date fruit as compared with control in both seasons. Generally, 10 g yeast/palm treatment showed superiority in this respect.

Moreover, 200 and 400 g zinc sulfate/palm treatments gave a similar and high positive effect on TSS/acidity in first seasons. Shortly, 400 g zinc sulfate/palm treatment proved to be the superior treatment in this concern.

On the other hand, the interaction between two factors produced a pronounced effect on TSS/acidity as compared with control in both seasons. Generally, 10 g/palm yeast combined with 200 and 400 g zinc sulfate/palm treatments surpassed other treatment in first seasons. Moreover, 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment scored the highest values in the second season.

3.6.11. Fruit total sugar content

Table 16, indicates that the yeast treatments had no statistically positive effect on total sugar in the first season. However, in second season yeast treatments significantly increased total sugar as compared with control. However, 10 g yeast/palm treatment proved to be the superior treatment in the second season.

Moreover, 200 and 400 g zinc sulfate/palm treatments gave statistically similar and high positive effect on total sugar as compared with control in the first season. Moreover, 400 g zinc sulfate/palm proved to be the best treatment in the second season.

Furthermore, the interaction between yeast and zinc sulfate gave a positive effect on total sugar as compared with control in both seasons. Generally, 10 g yeast/palm treatment combined with 400 g zinc sulfate/palm treatment surpassed other combinations in enhancing total sugar in both seasons.

4. Discussions

4.1 Leaf mineral content

The positive effects of applying yeast could be due to yeast contain tryptophan which consider precursor of IAA (Moor, 1979). Yeast aids in activating photosynthesis process through enhancing the release of carbon dioxide (Larson et al., 1962).

In addition, yeast application on flame seedless grape vines was very effective in releasing CO_2, which reflected on improving net photosynthesis (Hashem et al., 2008). However, yeast contains cytokinins and some important nutrients as N, P, K and some common amino acids (Abou-Zaid, 1984).

The obtained results regarding the effect of yeast on alleviating the adverse effect of salinity on leaf mineral content go in line with the findings of Ahmed and Ragab (2002) on "Picual" olive trees ; Abdelaal et al. (2013) on "Valencia" orange trees and El-Sayed (2013) on "Aggizy" olive trees. They mentioned that yeast application enhanced leaf mineral content of aforementioned fruit species.

Table 15. Effect of yeast, zinc sulfate soil application and their interaction on T.S.S. and acidity of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	T.S.S. (%)								Acidity (%)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	24.43 h	27.53 e	28.16 d	**26.71 C**	24.60 e	27.36 c	27.73 bc	**26.56 C**	0.32 a	0.27 c	0.27 c	**0.28 A**	0.32 a	0.27 cd	0.27 cd	**0.28 A**
5	25.40 g	28.56 d	29.26 c	**27.74 B**	25.40 de	28.53 b	28.73 b	**27.55 B**	0.29 b	0.26 cd	0.25 de	**0.27 B**	0.29 b	0.26 d	0.25 d	**0.27 B**
10	26.83 f	30.03 b	30.80 a	**29.22 A**	26.23 d	30.33 a	30.90 a	**29.15 A**	0.28 bc	0.23 f	0.21 f	**0.24 C**	0.28 c	0.23 e	0.21 e	**0.24 C**
Mean	**25.55 C**	**28.71 B**	**29.41 A**		**25.41 B**	**28.74 A**	**29.12 A**		**0.29 A**	**0.25 B**	**0.24 C**		**0.29 A**	**0.25 B**	**0.24 B**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

Table 16. Effect of yeast, zinc sulfate soil application and their interaction on T.S.S./acidity and fruit total sugar content of "Hayany" date palm trees (2013 and 2014 seasons).

Yeast g per palm	T.S.S./acidity (%)								Total sugar (%)							
	2013				2014				2013				2014			
	Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm				Zinc sulfate g / palm			
	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**	0	200	400	**Mean**
0	76.33 d	102.24bc	104.37 bc	**94.31 C**	77.10 c	100.16 de	101.47de	**92.91 C**	23.66 c	26.06 abc	26.30 abc	**25.34 A**	23.53 g	25.66 e	26.36 d	**25.18 C**
5	83.61 d	109.87 b	114.01 b	**102.49 B**	85.64 fg	108.46 cd	114.93 c	**103.01 B**	24.80 bc	26.56 abc	26.96 abc	**26.11 A**	24.66 f	26.76cd	27.16 c	**26.20 B**
10	95.86 c	126.97 a	135.30 a	**119.37 A**	93.77 ef	128.60 b	143.26 a	**121.87 A**	25.43abc	27.86 ab	29.10 a	**27.46 A**	25.03 f	28.63 b	29.40 a	**27.68 A**
Mean	**85.27 B**	**113.02 A**	**117.89 A**		**85.50 C**	**112.10 B**	**119.88 A**		**24.63 B**	**26.83 A**	**27.45 A**		**24.41 C**	**27.02 B**	**27.64A**	

Means followed by the same letter (s) within each row, column or interaction are not significantly different at 5% level.

The positive effect of zinc on leaf mineral content through alleviating the adverse effect of salinity may be attributed to its stimulating effect on enzyme activity, production of some phytohormones, improving the uptake of nutrients and the conversion of phosphorous insoluble form into soluble one thereupon, enhances phosphorous availability to plants (Abbas, 2013). Moreover, zinc plays a fundamental role in many essential cellular functions such as protein metabolism and IAA (Marschner, 1995). Moreover, zinc could alleviate alterations in NaCl plants in areas affected by salt (Marschner and Cakmak, 1989 and Parker et al., 1992), which was confirmed by (Alpaslan et al., 1999).

The obtained results of zinc regarding its positive effect on leaf mineral content are in harmony with the findings of Hasani et al. (2012). They mentioned that Zn treatment improved leaf nutrients concentration of pomegranate.

4.2. Leaf total chlorophyll content, Fruit set (%), Retained fruit (%), Yield (kg)/tree and Bunch weight (kg)

The beneficial effect of yeast application on leaf total chlorophyll content, fruit set, retained fruit and yield through alleviating the adverse effect of salinity may be attributed that yeast contains tryptophan which consider a precursor of IAA (Moor, 1979). In addition, application of yeast on flame seedless grape vines was very effective in releasing CO_2, which reflected on improving net photosynthesis (Hashem et al., 2008).

The obtained results of yeast regarding their positive effect on leaf total chlorophyll content, fruit retained and yield through alleviating the adverse effect of salinity are in harmony with the findings of Mostafa and Abou Raya (2003) recorded that, yeast soil application improved growth parameters of Grand Nain banana cv. compared with control without yeast treatment. Furthermore, Aki et al. (1997) mentioned that l0g yeast /l enhanced fruit set and yield of Red Roomy grapevine. However, Gadalla et al. (2011) demonstrated that yeast as foliar spray at 75g/l, 50g/l followed by 25 g/l per tree for twice spray (during fruit set stage on May and during fruit development on July) are recommended for improving yield of Hayany and Sewy date palm cultivars. However, Abdelaal et al. (2013) showed that yeast and /or combined with compost, EM and potassium alleviated salinity stress and improved leaf characters, growth and yield of under salt stress of "Valencia" orange trees. Moreover, El-Sayed (2013) indicated that soil application of 10 g yeast /tree and 60 g humic acid /tree improved yield as well as alleviated salinity stress of "Aggizy" olive trees. Furthermore, Abd El-Motty and Orabi (2014) indicated that yeast and zinc treatments enhanced yield of Novel orange trees. The best results obtained from zinc followed by yeast.

On the other hand, the positive effect of zinc which in enhancing the studied traits fruit retained and yield through alleviating salinity stress may be attributed to zinc is an essential metal for normal plant growth and development (Cakmak, 2000). It plays a fundamental role in many essential cellular functions such as protein metabolism and IAA (Marschner, 1995). Moreover, zinc is an important component of many vital enzymes, including ribulose-1, 5-bisphosphate carboxylase involved in photosynthesis, which catalyzes the initial step of carbon dioxide fixation in of photosynthesis. In addition, zinc could alleviate alterations in NaCl plants in areas affected by salt (Marschner and Cakmak, 1989 and Parker et al., 1992), which was confirmed by (Alpaslan et al., 1999). Furthermore, Aktas et al. (2006) indicated that an adequate Zn nutrition reduces excess uptake of Na by roots in saline conditions. An adequate Zn nutrition is important for the maintenance of good growth and yield under saline conditions of Pepper Plants.

The obtained resulted regarding the effect of zinc on fruit set, fruit retained and yield through alleviating the adverse effect of salinity go in line with the findings of Khoshgoftarmanesh et al. 2001 who found that zinc sulfate increases plant tolerance to salinity in wheat and enhanced yield as well as improve grain quality under salinity stress. Moreover, Khayyat et al. (2007) reported that zinc seems to play an important role in achieving a satisfactory fruit set, fruit retention and yield of "Shahany" date palm. However, Hasani et al. (2012) mentioned that Zn treatment improved yield of pomegranate. Moreover, Zhang et al. (2014) reported that soil application of B and Zn improved number of fruit per tree and yield of Satsuma mandarin.

4.3. Fruit properties

The enhancement effect of yeast on alleviating the adverse effect of salinity on fruit quality may be attributed that yeast richness in protein and its B vitamin group content (thiamin, riboflavin and pyridoxines), also yeast are prolific producers vitamins, amino acid, hormones and other growth regulating substances (Harrison, 1968). Moreover, yeast contains tryptophan which consider precursor of IAA, so it increases size of fruit (Moor, 1979). Yeast aids in activating photosynthesis process through enhancing the release of carbon dioxide (Larson et al., 1962). In addition, application of yeast on flame seedless grape vines was very effective in releasing CO_2, which reflected on improving net photosynthesis (Hashem et al., 2008).

The obtained results regarding the effect of active dry yeast on fruit quality go in line with the findings of Gadalla et al. (2011) showed that yeast as foliar spray at 75g/l, 50g/l followed by 25 g/l per tree for twice spray (during fruit set stage on May and during fruit development on July) are recommended for improving fruit quality of "Hayany" and "Sewy" date palm cultivars. Furthermore, El-Sayed (2013) indicated that soil application of yeast at 10 g/tree and humic acid at 60 g/tree fruit quality as well as alleviated salinity stress of "Aggizy" olive trees. Furthermore, Abd El-Motty and Orabi (2014) indicated that yeast and zinc treatments enhancement fruit quality of Novel orange trees.

The enhancement effect zinc on alleviating the adverse effect of salinity on fruit quality may be attributed that zinc is an essential metal for normal plant growth and development (Cakmak, 2000). It plays a fundamental role in many essential cellular functions such as protein metabolism and IAA (Marschner, 1995). It is well known that zinc is an important component of many vital enzymes, including ribulose-1, 5-bisphosphate carboxylase involved in photosynthesis, which catalyzes the initial step of carbon dioxide fixation in of photosynthesis (Brown et al., 1993).

The obtained results of zinc regarding its positive effect fruit quality are in harmony with the findings Khayyat et al. (2007) on "Shahany" date palm. However, Hasani et al. (2012) mentioned that Zn treatments improved quality of pomegranate. Moreover, Zhang et al. (2014) reported that soil application of B and Zn improved fruit quality of Satsuma mandarin.

Conclusively, from the obtained results and under similar conditions it is preferable to add yeast especially at 10 g/palm and zinc sulphate at 400 g /palm alone or in combination as soil application at three times a year i.e. February 1st, May 1st and July 1st, to enhance leaf chlorophyll content, fruit set percentage, retained fruit percentage, yield, fruit quality and leaf mineral content as well as alleviating salinity stress of "Hayany" date palm.

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