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Research article

Response of Nonpareil seedlings almond to foliar application of liquorice root extract and bread yeast suspend under South Sinai conditions

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Abstract

This study was carried out in two successive seasons 2014 & 2015 on two year old almond (*Prunus amygdalus Batsch* cv. Nonpareil) seedlings at El Tor, South Sinai governorate, Egypt. The investigation aimed to study the effect of foliar application with liquorice root extract (5, 10 g/L), bread yeast suspend (5, 10 g/L) alone or in combinations on seedlings growth and nutrient status. The obtained results revealed that the foliar application of both materials was very effective in improving vegetative growth characteristics of almond seedlings. The combined application of liquorice root extract 10 g/L plus bread yeast suspend 10 g/L gave the highest significant stem length and diameter, number of branches and leaves /seedling, leaf area, shoot fresh and dry weight in both seasons. The highest significant total chlorophyll, leaf fresh and dry weight were recorded from the interaction between 10 g/L liquorice root extract plus 5 g/L bread yeast suspend during two seasons. Leaves N, Mn contents were significantly increased by treated with liquorice root extract 10 g/L plus bread yeast suspend 10 g/L. The interaction between liquorice root extract 5 g/L plus bread yeast suspend 10 g/L gave the highest significant leaf Fe content in both seasons. While P, K, Mg, Ca, Zn leaf contents were not significantly affected by different concentrations of liquorice root extract, bread yeast suspend and their interactions in both seasons of the study. Shoots mineral contents (N, P, K, Mg, Fe and Mn) were not significantly affect, except Ca in the second season only was significantly increased after foliar with 10 g/L liquorice root extract plus 5 g/L bread yeast suspend. Also, application of liquorice root extract 10 g/L plus bread yeast suspend 10 g/L gave the highest significant Zn in both seasons. It can be recommended from the present study that foliar application with liquorice root extract at 10 g/L plus bread yeast suspend at 10 g/L for improving and enhancing growth, leaf and shoot mineral contents of Nonpareil almond seedlings.

Key words: Almond, liquorice root extract, bread yeast suspend, growth, nutrient status, seedlings.

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1. Introduction

Almond (*Prunus amygdalus* B.) belongs to the family Rosaceae. It is one of the important nut crops. Almond kernels are concentrated source of energy, supplying significant amounts of fats 53.37%, protein

20.51% fiber 3.05% and total sugar 766 mg/100g. The fat is primarily unsaturated, mostly oleic and linoleic fatty acids. On the other hand, unsaturated fatty acids are important in maintaining lower blood cholesterol levels [1, 2]. Also includes considerably macro and micro nutrients K 5.52%, P 364 mg/100 g, Mg 227 mg/100 g ,Ca 185 mg/100 g, Cu 5 ppm, Zn 34 ppm and Fe 70 ppm [3]. Moreover, it is a good source of vitamins specially niacin, riboflavin and thiamin [4].

Although availability of environmental conditions for successful almond cultivation in Egypt especially in north and south Sinai, but agriculture is still limited on a commercial scale. So experiments and studies for expansion in the cultivation of this crop in these areas have to be carried out especially climatic factors are suitable for growth and fruiting to fill consumer needs especially during the month of Ramadan. Locally production of almond fruits save a large of hard currency spends annually to import these fruits to face the needs of the Egyptians. Almond fruits also are used in sweet industries. To access this objective some practices such as spraying natural plants extracts are suggested.

Liquorice root extract (*Glycyrrhiza glabra*) family Leguminoseae, is a plant which grows in Egypt and some other countries of the world. Its roots possess some nutritive value and medicinal properties [5]. The liquorice root extract contains more than 100 various compounds, the important of them are phenolic compounds [6-7], flavonoids, protein, amino acid (Asparagin), monosaccharide (glucose, fructose, sucrose and maltose), lignins, tannins, starch, choline, phytosterols, different types of vitamins such as B1, B2, B3, B6, C, E, biotin, foli acid, pantothenic acid and many mineral compounds (P, K, Al, Ca, Fe, Mn, Co, Zn, Na and Si) [8-10]. Sheren and Eman [11] found that spraying with liquorice root extract improving growth parameters (leaf area, chlorophyll, shoot length, shoot diameter) and leaf mineral contents (nitrogen, phosphorus and potassium).

Bread yeast may be used as soil applications, spray solutions or soaking solutions, because dry yeast is containing several nutrients including N, P, K, Mg, Ca, Na, Mn, Zn, Cu, B and Mo, total protein (5.3%), total carbohydrates (4.7%), and some hormones (IAA 0.5 ppm and GA_3 0.3 ppm) [12]. The first possibility of using the active bread yeast for improving growth and fruit quality was published by Suriabananont [13]. However, the different positive effects of applying active bread yeast as a newly used bio-fertilizer were attributed to its own component from different nutrients, a higher percent of proteins, massive amount of vitamin B and the natural plant growth hormone namely cytokinins [14-16]. Today, bread yeast (*Saccharomyces cerevisiae*) as a natural bio-stimulant appeared to induce an astonished influence on growth and yield of many crops, since it has various basic functions, i.e. CO_2 production as well as formation of alcohol, acids and esters [17-18].

However, this study was planned to optimize the growth and nutrient status of Nonpareil almond seedlings grown at El Tor, South Sinai by using liquorice root extract and bread yeast suspend.

2. Materials and Methods

Plant Materials and Treatments

The present study was carried out during two successive seasons 2014 and 2015 seasons on two year old almond seedlings (*Prunus amygdalus* B.) cv. Nonpareil budded on bitter almond rootstock, uniform in vigor, with planting space 5 × 5 m grown in sandy soil. Chemical properties are showing in Table 1 under drip irrigation system at El Tor, South Sinai governorate, Egypt. Nine treatments were established as follows:

1. Control treatment (spraying with water).
2. Liquorice root extract at 5g/L.
3. Liquorice root extract at10 g/L.
4. Bread yeast suspend at 5g/L.
5. Bread yeast suspend at 10g/L.
6. Liquorice root extract at 5g/L + Bread yeast suspend at 5g/L.
7. Liquorice root extract at 5g/L + Bread yeast suspend at 10g/L.
8. Liquorice root extract at 10g/L + Bread yeast suspend at 5g/L.
9. Liquorice root extract at 10g/L + Bread yeast suspend at 10g/L.

All treatments were sprayed twice, month interval between each one and other, started at the end of April. Bread yeast suspend sprayed two weeks after the first spray of liquorice root extract in interaction between treatments. The aqueous extract of liquorice roots (*Glycyrrhiza glabra*) were prepared by blending (5g or 10g) in one liter of distilled water 50°C for 24 hours. The solution filtered by wringing using a mutton cloth. The obtained extract re-filtered through Whatman No. 2 filter paper and completed by distilled water to one liter. Dry yeast was brewed for 6 hours to prepare suspend of bread yeast (*Saccharomyces cerevisiae*), 10 g dry yeast +10 g sugar + 1000 ml water, according to Sommer R [19]. The experiments established in randomized complete block design with three replicates for each treatment and each replicate was represented by five seedlings.

The following parameters were measured for both seasons:

Vegetative growth and total leaf chlorophyll content

At the end of the August, stem length and diameter (cm), leaves and branches numbers/ seedlings; leaves fresh and dry weights (g) and shoot fresh and dry weights (g) were determined. Leaf area (cm^2) was measured by using Cl-202 portable laser leaf area meter. Leaf chlorophyll content was measured in the field by using chlorophyll meter model SPAD- 502.

Leaves and shoots mineral content

Leaves and shoots samples were picked from each treatment and dried at 70°C till a constant weight for the determination of the following nutrient elements (percentage as dry weight) N, P, K, Mg, Fe, Mn and Zn according to AOAC [20].

Statistical analysis

All data were subjected to analysis of variance (ANOVA) as described by Mstat-C [21] and the least significant differences (L.S.D) was used to compare between treatment means separated using Duncan's Multiple Range Test (DMRT) at a probability of 5%.

Table 1. Chemical properties of the experimental soil

Soil depths (cm)	pH (1:2.5)	EC(1:5) dSm^{-1}	Soluble cations (meq/L)				Soluble anions (meq/L)			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{--}
0-30	9.4	0.34	1.5	0.5	1.2	0.25	-	0.6	1.25	1
30-60	8.5	1.5	11.5	2.5	0.8	0.39	-	4.5	1.6	9.69

3. Results and Discussion

Vegetative growth and total leaf chlorophyll content

It is obvious from Tables 2 and 3 that vegetative growth characteristics and total chlorophyll of Nonpareil almond seedlings were influenced significantly as a result of foliar application with liquorice root extract and bread yeast suspend in both seasons of this study. The combined application of liquorice root extract 10 g/L plus bread yeast suspend 10 g/L gave the highest significant stem length (130 and 124 cm), stem diameter (2.55 and 2.61 cm), number of branches (27 and 30/ seedling), number of leaves (398 and 396/ seedling) and leaf area (3.14 and 2.85 cm^2) in both 2014 and 2015 seasons respectively. While the combined treatment of the both materials 10 g/L liquorice root extract plus 5 g/L bread yeast suspend gave the highest total chlorophyll (42.70 and 45.12), leaf fresh weight (45.26 and 40.37 g) and leaf dry weight (37.76 and 35.47 g) in the first and second seasons respectively. Whereas the highest shoot fresh weight (62.14 and 61.38 g) and shoot dry weight (55.14 and 55.08 g) were recorded from the interaction between 10 g/L liquorice root extract plus 10 g/L bread yeast suspend during the two seasons respectively. On the other hand, the control gave the lowest values of these parameters in both seasons of this study.

Table 2. Effect of foliar application with liquorice root extract and bread yeast suspend on stem length, stem diameter, number of branches, number of leaves/seedling and leaf area of Nonpareil almond seedlings during 2014 and 2015 seasons.

Treatments	Stem Length (cm)		Stem Diameter (cm)		No. of branches/ seedling		No. of leaves/ seedling		leaf area (cm^2)	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**	**2014**	**2015**
Control	103f	104c	1.72d	1.83b	12e	19c	137e	210e	2.35g	2.50b
L (5g/L)	105f	109bc	1.91cd	1.82b	18d	19c	290de	235de	2.44f	2.51b
L (10g/L)	113e	111bc	2.12bc	1.95b	19d	20c	109cd	249cde	2.47f	2.53b
Y (5g/L)	116de	117ab	2.24abc	1.96b	20cd	20c	248bc	283bcde	2.54e	2.54b
Y (10g/L)	117cde	120a	2.33ab	2.00ab	21bcd	21bc	261bc	319abcd	2.56de	2.65ab
L (5g/L) + Y (5g/L)	122cd	121a	2.34ab	2.22ab	23bc	22abc	290b	320abcd	2.61d	2.80a
L (5g/L) + Y (10g/L)	123bc	122a	2.52a	2.23ab	23bc	26abc	295b	340abc	2.77c	2.83a
L (10g/L) + Y (5g/L)	129ab	123a	2.54a	2.23ab	24ab	29ab	383a	353ab	2.86b	2.84a
L (10g/L) + Y (10g/L)	130a	124a	2.55a	2.61a	27a	30a	398a	396a	3.14a	2.85a

Means in each column with similar letters are not significantly different.
L= Liquorice root extract
Y= Bread yeast suspend

Table 3. Effect of foliar application with liquorice root extract and bread yeast suspend on total chlorophyll, leaf fresh weight, leaf dry weight, shoot fresh weight and shoot dry weight of Nonpareil almond seedlings during 2014 and 2015 seasons.

Treatments	Total chlorophyll		L.F.W (g)		L.D.W (g)		S.F.W (g)		S.D.W (g)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	25.53 d	35.42 c	20.12 c	21.35 c	15.71 b	17.89 d	28.17 d	30.44 c	24.27 d	23.95 d
L (5g/L)	25.61 d	38.11 bc	20.31 c	23.14 c	15.52 b	19.68 cd	36.11 cd	38.08 bc	29.43 cd	31.59 cd
L (10g/L)	32.54 c	38.41 abc	20.31 c	25.34 c	26.48 ab	21.88 cd	36.63 cd	39.09 bc	30.61 cd	32.60 cd
Y (5g/L)	33.23 c	38.60 abc	31.48 bc	26.12 c	29.39 a	22.66 cd	45.62 bc	39.09 bc	37.45 c	35.82 cd
Y (10g/L)	40.94 ab	40.00 abc	38.19 ab	29.34 bc	30.21 a	24.44 bcd	48.37 b	43.93 b	41.42 bc	37.44 bc
L (5g/L) + Y (5g/L)	41.92 ab	42.50 ab	38.29 ab	30.43 abc	33.05 a	26.97 abc	55.18 ab	55.64 a	50.18 ab	49.34 ab
L (5g/L) + Y (10g/L)	42.40 ab	43.10 ab	40.19 ab	37.91 ab	34.29 a	33.01 ab	60.21 a	60.11 a	52.21 ab	53.81 a
L (10g/L) + Y (5g/L)	42.70 a	45.12 a	45.26 a	40.37 a	37.76 a	35.47 a	60.37 a	60.19 a	54.97 a	53.89 a
L (10g/L) + Y (10g/L)	37.93 b	44.10 ab	40.21 ab	38.17 ab	34.79 a	33.27 ab	62.14 a	61.38 a	55.14 a	55.08 a

Means in each column with similar letters are not significantly different.
L= Liquorice root extract
Y= Bread yeast suspend

Leaf mineral content

Leaf Macro-Elements

Results in Table 4 indicated that nitrogen leaf content influenced significantly as a result of foliar application with liquorice root extract and bread yeast suspend each alone or with each other. During both seasons of the study nitrogen content in the leaves increased significantly due to all treatments compared with the control. The highest significant N percentage in leaves (1.62 and 1.82%) were obtained in the combined application of liquorice root extract 10 g/L plus bread yeast suspend 10 g/L during seasons 2014 and 2015 respectively. The lowest significant N percentage in leaves (1.15 and 1.35%) was obtained in the control during seasons 2014 and 2015 respectively. Leaves phosphorus, potassium and magnesium contents were not significantly affected by different concentrations of liquorice root extract, bread yeast suspend and their interactions in both seasons of the study. Moreover, liquorice root extract at 10 g/L plus bread yeast suspend at 10 g/L achieved high P percentage in leaves (1.03 and 1.10% in the 1st and 2nd seasons) and Mg percentage in leaves (0.12 and 0.16% in the 1st and 2nd seasons) whereas the highest K percentage in leaves (2.17 and 2.47% in the 1st and 2nd seasons) was recorded from the interaction treatment between 10 g/L liquorice root extract plus bread 5 g/L yeast suspend.

Table 4. Effect of foliar application with liquorice root extract and bread yeast suspend on leaf macro-elements of Nonpareil almond seedlings during 2014 and 2015 seasons.

Treatments	N%		P%		K%		Mg%	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	1.15c	1.35d	0.77a	0.87a	1.78a	2.08a	0.03a	0.07a
L (5g/L)	1.29bc	1.49c	0.78a	0.88a	1.78a	2.08a	0.03a	0.07a
L (10g/L)	1.29bc	1.49c	0.78a	0.88a	1.78a	2.08a	0.03a	0.07a
Y (5g/L)	1.48ab	1.68bc	0.79a	0.89a	2.02a	2.32a	0.03a	0.07a
Y (10g/L)	1.48ab	1.68bc	0.83a	0.93a	2.02a	2.32a	0.03a	0.07a
L (5g/L) + Y (5g/L)	1.48ab	1.68bc	0.85a	0.96a	2.00a	2.30a	0.03a	0.07a
L (5g/L) + Y (10g/L)	1.51ab	1.71ab	0.86a	0.95a	2.16a	2.46a	0.03a	0.07a
L (10g/L) + Y (5g/L)	1.55ab	1.75ab	0.86a	0.95a	2.17a	2.47a	0.03a	0.07a
L (10g/L) + Y (10g/L)	1.62a	1.82a	1.03a	1.10a	2.15a	2.45a	0.12a	0.16a

Means in each column with similar letters are not significantly different.
L= Liquorice root extract
Y= Bread yeast suspend

Leaf Micro-Elements

Data in Table 5 indicated that leaf calcium and zinc contents were not significantly affected by different concentrations of liquorice root extract, bread yeast suspend and their interactions in both seasons of the study. On the other side, leaf iron and manganese contents were influenced significantly as a result of foliar application with liquorice root extract and bread yeast suspend alone or in combination. The highest significant leaf iron content (259.3 and 260.9 ppm) were recorded from the interaction between liquorice root extract 5 g/L plus bread yeast suspend 10 g/L in the first and second seasons, respectively. The lowest significant leaf iron content (209.4 and 211 ppm) was recorded from the control in both seasons respectively. While the combined treatment of both materials (10 g/L liquorice root extract plus 10 g/L bread yeast suspend) gave the highest significant leaf manganese content (55.50 and 62.22 ppm) during both seasons 2014 and 2015 respectively. The lowest significant leaf manganese content (53.61 and 39.28 ppm) was recorded from the control in both seasons respectively.

Shoot mineral content

Shoot Macro-Elements

Results in Table 6 show that shoots nitrogen, phosphorus, potassium and magnesium contents were not significantly affected by different concentrations of liquorice root extract, bread yeast suspend and their interactions in both seasons of the study. Liquorice root extract at 10 g/L plus bread yeast suspend at 10 g/L achieved high N percentage in shoots (1.44 and 1.84% in the 1st and 2nd seasons), P percentage in shoots (0.51 and 0.70 in the 1st and 2nd seasons) and Mg percentage in shoots (0.034 and 0.038% in the 1st and 2nd seasons) whereas the highest K percentage in shoots (0.82 and 0.84% in the 1st and 2nd seasons) was recorded from the interaction treatment between 5 g/L liquorice root extract plus bread 10 g/L yeast suspend.

Table 5. Effect of foliar application with liquorice root extract and bread yeast suspend on leaf micro-elements of Nonpareil almond seedlings during 2014 and 2015 seasons.

Treatments	Ca%		Fe (ppm)		Zn (ppm)		Mn (ppm)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	1.12a	1.17a	209.4b	211.0b	16.56a	19.06a	53.61b	39.28b
L (5g/L)	1.18a	1.18a	209.9b	211.6b	16.63a	19.13a	54.34ab	39.38b
L (10g/L)	1.24a	1.29a	210.4b	212.0b	17.75a	20.25a	54.62ab	39.76b
Y (5g/L)	1.19a	1.28a	242.3ab	243.9ab	18.04a	20.54a	54.65ab	46.17ab
Y (10g/L)	1.16a	1.23a	242.5ab	244.1ab	18.18a	20.68a	54.79ab	46.21ab
L (5g/L) + Y (5g/L)	1.16a	1.21a	244.2ab	245.8ab	18.97a	21.47a	54.79ab	49.98ab
L (5g/L) + Y (10g/L)	1.13a	1.21a	259.3a	260.9a	19.40a	21.90a	54.79ab	50.60ab
L (10g/L) + Y (5g/L)	1.24a	1.29a	258.9a	259.8a	19.66a	22.16a	55.09a	52.24ab
L (10g/L) + Y (10g/L)	1.25a	1.30a	258.2a	260.5a	20.22a	22.72a	55.50a	62.22a

Means in each column with similar letters are not significantly different.
L= Liquorice root extract
Y= Bread yeast suspend

Table 6. Effect of foliar application with liquorice root extract and bread yeast suspend on shoot macro-elements of Nonpareil almond seedlings during 2014 and 2015 seasons.

Treatments	N%		P%		K%		Mg%	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	1.18a	1.58a	0.41a	0.60a	0.72a	0.94a	0.030a	0.026a
L (5g/L)	1.18a	1.58a	0.43a	0.62a	0.73a	0.95a	0.030a	0.027a
L (10g/L)	1.18a	1.58a	0.46a	0.65a	0.74a	0.96a	0.030a	0.027a
Y (5g/L)	1.26a	1.66a	0.47a	0.66a	0.81a	1.02a	0.030a	0.030a
Y (10g/L)	1.37a	1.77a	0.47a	0.66a	0.81a	1.03a	0.030a	0.030a
L (5g/L) + Y (5g/L)	1.40a	1.80a	0.48a	0.67a	0.80a	1.03a	0.030a	0.030a
L (5g/L) + Y (10g/L)	1.40a	1.80a	0.48a	0.67a	0.82a	1.04a	0.033a	0.037a
L (10g/L) + Y (5g/L)	1.40a	1.80a	0.48a	0.67a	0.81a	1.03a	0.033a	0.037a
L (10g/L) + Y (10g/L)	1.44a	1.84a	0.51a	0.70a	0.81a	1.03a	0.034a	0.038a

Means in each column with similar letters are not significantly different.
L= Liquorice root extract
Y= Bread yeast suspend

Shoot Micro-Elements

Table 7 show that shoot calcium content was not significantly affected by different concentrations of liquorice root extract, bread yeast suspend and their interactions in the first season. In the second season 10 g/L liquorice root extract plus 5 g/L bread yeast suspend gave the highest significant shoot calcium content (1.01%). Shoot iron and manganese contents were not significantly influenced as a result of foliar application with liquorice root extract and bread yeast suspend alone or in combination in both seasons. On the other hand, shoot zinc content was significantly affected by different concentrations of liquorice root extract, bread yeast suspend and their interactions in both seasons of the study. The highest significant shoot zinc content (24.23 and 27.67 ppm) were recorded from the interaction between liquorice root extract 10 g/L plus bread yeast suspend 10 g/L in the first and second seasons, respectively. The lowest significant shoot zinc content (15.68 and 19.12 ppm) was recorded from the control in both seasons 2014 and 2015, respectively.

Table 7. Effect of foliar application with liquorice root extract and bread yeast suspend on shoot micro-elements of Nonpareil almond seedlings during 2014 and 2015 seasons.

Treatments	Ca%		Fe (ppm)		Zn (ppm)		Mn (ppm)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	0.70a	0.75b	176.3a	178.2a	15.68f	19.12f	13.24a	14.43a
L (5g/L)	0.72a	0.77b	179.3a	181.2a	17.13ef	20.57ef	16.29a	17.48a
L (10g/L)	0.72a	0.79ab	218.2a	220.1a	18.13e	21.57e	16.87a	18.06a
Y (5g/L)	0.74a	0.89ab	182.3a	184.3a	18.73de	22.17de	19.34a	20.53a
Y (10g/L)	0.75a	0.93ab	183.9a	185.8a	20.18cd	23.62cd	19.92a	21.11a
L (5g/L) + Y (5g/L)	0.76a	0.94ab	187.0a	188.9a	21.18c	24.62c	22.97a	24.16a
L (5g/L) + Y (10g/L)	0.77a	0.96ab	180.9a	182.8a	21.78bc	25.22bc	26.70a	27.89a
L (10g/L) + Y (5g/L)	0.82a	1.01a	212.1a	214.0a	23.23ab	26.67ab	32.80a	33.99a
L (10g/L) + Y (10g/L)	0.80a	0.97ab	215.1a	217.0a	24.23a	27.67a	29.75a	30.94a

Means in each column with similar letters are not significantly different.
L= Liquorice root extract
Y= Bread yeast suspend

Discussions

The enhancement in vegetative growth characteristics, leaf and shoot mineral contents of Nonpareil almond seedlings may be attributed to its effects of application with liquorice extract which contains more than 100 various compounds [6-7] most important of them are triterpene saponins (including glycyrrhizin), phenolic compounds, mevalonic acid which is the initiator in the synthesis of GA_3 acid in plants, protein amino acid (asparagin), polysaccharide (glucose, fructose, sucrose, maltose) lignins, vitamins such as B1, B2, B3, B6, C and E, Biotin, folic acid, pantothenic acid and many mineral compounds (P, K, Al, Ca, Fe, Mn, Co, Zn, Na and Si) which play an important role in improving the growth of the plants [8-10]. These results are in agreement with Sheren AA et al. [11] on 'Le Conte' pear and Zuhair AD [22] on two strawberry varieties who studied the effect of licorice extract as a foliar spray on vegetative growth and found that a significant increase in vegetative growth. Moreover, the effect of bread yeast suspend in increasing levels of endogenous hormones like auxin, cytokinins and GA_3 in treated plants which could be interpreted by cell division and cell elongation. In addition, it's content of vitamins, amino acids, carbohydrates and different nutrients as N, P, K, Mg, Ca, Na, Mn, Zn, Cu, B and Mo which increased the metabolic processes role and its effect in activating photosynthesis process through enhancing the release CO_2 and stimulating photosynthesis which would be reflected on seedlings growth [14, 23]. The results are in harmony with those obtained by [24-29] recorded that application of dry yeast increased leaf area, leaf, fresh and dry weights, total chlorophyll contents and leaf mineral content (N, P, K, Fe, Zn and Mn) compared with control without dry yeast treatment.

Conclusion

It may be concluded that foliar application with liquorice root extract at 10 g/L plus bread yeast suspend at 10 g/L for improving and enhancing growth characteristics, leaf and shoot mineral contents of Nonpareil almond seedlings plants at El Tor, South Sinai governorate, Egypt. In addition, it can be recommended that spray liquorice root extract as natural plant extracts for various crops due to its high potentiality, high nutritive value and easy preparation, besides their safety for either environment or human health.

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