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Effect of Foliar Spray with Yeast Suspension and Foliartal Nutrient Solution on the Mineral Content of Tissue Lime Seedlings *Citrus limon* L.

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Abstract. This study was done in green house of college of Agricultural engineering sciences during the season 2019-2020 to study the effect of the foliar spray with yeast suspension , nutrition solution (Foliartal) and their interaction on some leaf nutrients contents of (*citrus limon* L.) lime seedling was produced from the tissue culture lab. Studied factors were three level (0,7 and 10) $g.L^{-1}$ and (0,3 and 5) $ml.L^{-1}$ of yeast suspension and foliartal nutrient respectively treatments were distributed in Randomized Completely Block Design (RCBD) with two replicates the test LSD used in order to compare between means at 0.05% probability . the results showed that treatments 10 $g.L^{-1}$ of yeast suspension gave the highest values (1.57 , 0.24, 1.48 ,7.44 and 0.53,)% and (19.31 , 114.63 , and 28.42)$mg.kg^{-1}$ for N,P,K,C, Mg, Mn,Fe and Zn respectively the foliar nutrient at 5 $ml.L^{-1}$ gave significantly increased in all this characters which (1.5 , 0.28 , 1.44 , 7.10 and 0.52)% and (18.64 , 115.35 and 29.33) $mg.kg^{-1}$ for characters respectively , also the interaction between yeast suspension10 $g.L^{-1}$ + foliartal nutrient 5 ml.L-1 gave the highest increment was (1.77, 1.62, 7.91 and 0.56) % and (20.89, 131.69 and 33.12) $mg.kg^{-1}$ respectively except phosphor percentage was highest value 0.29 % with (10 $g.L^{-1}$ +3$ml.L^{-1}$) while the control treatments (0 $g.L^{-1}$ + 0 $ml.L^{-1}$) gave lower number of leaf mineral contents.

Keywords. Foliar Spray, Nutrient Solution, Citrus limon L.

1. Introduction

Lemon (*Citrus limon* L.) Lemon belongs to the genus Citrus belong to family Rutaceae. The northeastern region of India and southwestern China are the original home of this variety [1], Lemon is one of the citrus fruits grown in Iraq due to its suitability to the environmental conditions, Also, because the fruit has characteristics that are acceptable to the consumer because it is rich in mineral salts such as calcium, sodium, iron, magnesium, sulfur and phosphorous. It is also a source of vitamin C, in addition, the fruit is used in the manufacture of juices and for fresh consumption, In addition to its effective role in the treatment of many diseases and its use with foods as appetizer to give them flavors [2]. Estimated the number of lemon trees planted in Iraq, according to the statistics of the Central statistical organization 2019 about 291537 trees and Iraq's production of lemons is about 5,178 tons [3]. Foliar nutrition can be used supplement to ground fertilization The plant needs nutrients in order to continue to grow and develop Because it is the basis for vital activities and metabolic activities Its deficiency leads to a physiological defect Through nutritional imbalance In

addition, some elements are fixed or lost, which leads to the failure of the root system to obtain the necessary elements from the soil, Therefore, spraying it on the vegetative system of the plant [4]. [5], found Spraying grape seedlings *Vitis vinivera* with the nutrient solution containing of macro and micro elements. This improved the growth characteristics and increased the content of the leaves from the (N,P,K) and [6], got The spraying of peach seedlings peento *Prunus Persica* L with hubest containing 85% humic acid and micro and macro elements led to an increase in elements (N, K) and carbohydrates in the branches at concentration 500 $mg.L^{-1}$ also [7], found There is an increase in some vegetative characteristics and the content of the leaves from the elements for seedlings of Loquat *Eriobotrya japonica* L When spraying with humic acid at a concentration of 2 ml. L^{-1} . and [8], got Increase in vegetative growth and dry matter in leaves when seedlings of *Ziziphus mauritiana* Lamk were sprayed with humic acid at 1.5 $ml.l^{-1}$ and $5ml.l^{-1}$ [9] found The highest percentage of carbohydrates and nitrogen in the leaves of the Figs black Diyala cultivar was 15.02% and 2.34% when spraying with foliar nutrient. Nitrogen is one of the most important elements that work on growth and development, especially in the early stages of its growth Where nitrogen can be obtained in its organic form from a yeast suspension [20] the studies showed that Chemical analysis of dry yeast Sacchromyse cervisiae components it contains (N 1.2 , P 0.13 , K 0.30, mg 0.013 , ca 0.02 and Na0.01)% beside to (Fe 0.13, Mn 0.07, Zn,Cu 0.04 , B 0.016 and Mo 0.0003)PPm As well as containing protein, carbohydrates, amino acids and sugars such as glucose and sucrose . [10], found The spraying of yeast on the on the vegetative system of mango trees with many concentrations led to an improvement in vegetative growth, beside to increase in the number of fruits and decreased in their fall. [11], revealed That there was an increase in the mineral content and the vegetative and fruitful growth when spraying the seedlings of kaki with yeast at level 4g $.l^{-1}$, [12], they mentioned There was a response of the grapes of the Black Hamburg cv to spraying with yeast suspension 10 g $.l^{-1}$, which led to increase in the content of chlorophyll in leaves and an increase in the percentage of carbohydrates and nitrogen in the branches . the research aimed to study the response of lemon seedlings which produced from tissue culture to spraying of nutrient solution and yeast suspension and their effect on the Mineral content of seedlings and their development.

2. Materials and Methods

This study was conducted in green house of college of Agricultural engineering sciences during the season 2019-2020 to study the effect of the foliar spray with yeast suspension and their interaction on lemon seedling which produced from a tissue culture laboratory , The seedlings were planted in plastic capacity 5 kg , Nutrient solution (Foliartal) contains humic acid , macro and micro elements,and the treatments have been prepared with three concentration H0, H1 and H2 (0 ,3 and 5)$mg.l^{-1}$ respectively and yeast suspension was sprayed with three concentration X0, X1 and X2 (0 ,5 and 10) $g.l^{-1}$, The yeast suspension was prepared by Using Turkish yeast which dissolved in water (7 and 10)$g.l^{-1}$ after that Sugar was added to activate the reaction [13], the seedlings were sprayed at dawn because the stomata were open and Used liquid soap 1 $ml.l^{-1}$ as a diffuser to reduce surface tension and increase absorption . the control treatments H0 and X0 were Just sprayed with water. Randomized Completely Block Design (RCBD) with two replicates the test LSD used in order to compare between means at 0.05% probability .

Estimate the elements of carbohydrates in the leaves as method [14], nitrogen [15], , phosphor [16], potassium and Fe, Zn ,Mn ,Mg [17].

3. Results and Discussion

3.1. The Percentage of Nitrogen in Branches (%)

The results in Table 1 presented The treatment of spraying with yeast suspension X2 gave highest value of 1.57%, with a significant difference from the treatment of X1 and X0, which amounted to (1.29 and 1.14)%, respectively . the results revealed treatment of spraying with the nutrient solution h2 achieved highest value 1.5 % was with significant difference while h0 gave less value 1.19% ,the interaction treatments (x2, h2) and (x2, h1) gave highest values 1.77 % and 1.57 % respectively on the contrary the less value was 0.95 % for (x0 ، h0) .

Table 1. Effect of spraying yeast suspension , nutrient solution and their interaction on the percentage of nitrogen in the leaves (%).

		H		
x	**H0**	**H1**	**H2**	**Mean X**
X0	0.95	1.17	1.37	1.14
X1	1.25	1.17	1.44	1.29
X2	1.37	1.57	1.77	1.57
	LSDX. H	0.10		LSD x 0.06
	1.19	1.30	1.50	
LSDH			0.06	

3.2. Percentage of Phosphorous in Leaves (%)

Data in table 2 shows that there were significant difference among the means of yeast suspension the mean of the nutrient solution and the interaction between of the yeast suspension and nutrient solution , where x1 and x2 gave highest average 0.24% while x0 gave the least 0.2% . in the same field the treatment h2 of nutrient solution was 0.28% compared to the lowest values h0 gave 0.23% . on the other hand the interaction between yeast suspension and nutrient solution were significant as (x2,h1) (x1,h1) (0.29 and 0.28)% respectively while (x0,h1) (x0, h2) gave minimum phosphor percentage 0.24%.

Table 2. Effect of spraying yeast suspension , nutrient solution and their interaction on the percentage of phosphorous in the leaves (%).

x	**H0**	**H1**	**H2**	**Mean X**
X0	0.25	0.24	0.24	0.20
X1	0.25	0.28	0.26	0.24
X2	0.26	0.29	0.26	0.24
	LSDX. H	0.02		LSD x0.01
	0.23	0.25	0.23	
LSDH			0.01	

3.3. The Percentage of Potassium in the Leaves (%)

The results in Table 3 showed that The potassium content in the leaves increased with yeast suspension treatments Where there is a significant increase for X2 (1.48)% while X0 and X1 gave least value (1.29)% , in the same field There was a Positive relationship between the potassium percentage and the concentration of the added nutrient solution were h1 and h2 gave higher values (1.44 and 1.41)% respectively compare to h0 gave (1.21)%. on the other hand the interaction treatments between yeast suspension and nutrient solution had a significant effect in increasing the percentage of potassium, especially the treatment (x2, h2) which gave the highest percentage of potassium with an increase of (35)% compare to (x0 ,h0) gave minimum percentage (1.20)%.

Table 3. Effect of spraying yeast suspension , nutrient solution and their interaction on the percentage of potassium in the leaves (%).

		H		
x	**H0**	**H1**	**H2**	**Mean X**
X0	1.20	1.33	1.25	1.29
X1	1.19	1.33	1.36	1.29
X2	1.25	1.56	1.62	1.48
	LSDX. H	0.18		LSD x 0.10
	1.21	1.41	1.44	
LSDH			0.10	

3.4. The Percentage of Magnesium in the Leaves (%)

The results in table 4 indicate that significant effect of yeast suspension X2 was recorded highest percentage (0.53)% followed by X1 and X0 gave (0.47 , 0.44)% respectively . also sprayed nutrient solution increase the percentage were h2 gave highest value 0.52% compare to h1 gave the least h0 (45)% . in the same field there is significant difference between the interaction were maximum percentage (30.23)% of x2,h2 while x0,h0 gave minimum (0.43)%.

Table 4. Effect of spraying yeast suspension , nutrient solution and their interaction on the percentage of magnesium in the leaves (%).

		H		
x	**H0**	**H1**	**H2**	**Mean X**
X0	0.43	0.44	0.47	0.44
X1	0.44	0.44	0.53	0.47
X2	0.47	0.55	0.56	0.53
	LSDX. H	0.04		LSD x 0.02
	0.45	0.48	0.52	
LSDH			0.02	

3.5. The Leaves Content of Manganese mg.kg^{-1}

Data presented in Table 5 indicate there is an increase of manganese for treatment x2 gave 19.31 mg.kg^{-1} with significant difference from x1, x0 gave (17.13 , 17.07) mg.kg^{-1} respectively . in another way nutrient solution reason to increase manganese Especially for h2 gave highest value 18.64 mg.kg-1 followed by h1 and h0 gave (17.92, 16.95) mg.kg-1 respectively , In addition, the interaction had an obvious effect in increased of manganese were x2, h2 gave highest value 20.89 mg.kg^{-1} while While x0,h1 gave the lowest values 16.32 mg.kg-1.

Table 5. Effect of spraying yeast suspension , nutrient solution and their interaction on the content of manganese in the leaves mg.kg^{-1}.

		H		
x	**H0**	**H1**	**H2**	**Mean X**
X0	16.87	17.18	17.65	17.13
X1	16.32	17.18	17.70	17.07
X2	17.65	19.39	20.89	19.31
	LSDX. H	1.11		LSD x 0.64
	16.95	17.92	18.64	
LSDH			0.64	

3.6. The Percentage of Carbohydrates in the Leaves (%)

Table 6 shows from the results obtained The percentage of carbohydrates in the leaves increased significantly as a result of spraying with yeast suspension to reach the highest percentage 7.44 % for x2 compared to x1 and x2 gave the least (6.67 ,6.56)% respectively .nutrient solution affected remarkably increasing that percentage and reached 7.1% for h2 followed by h1 gave 7.00 % while lowest values 6.56 % for h0. Also by the results find the interaction had significant effect were x2,h2 gave highest values 7.91% While the lowest values for (x1, h0) (,x0,h0) (6.5 ,6.51)% respectively .

Table 6. Effect of spraying yeast suspension , nutrient solution and their interaction on the percentage of carbohydrates in the leaves (%).

	H			
x	**H0**	**H1**	**H2**	**Mean X**
X0	6.51	6.64	6.68	6.56
X1	6.50	6.64	6.87	6.67
X2	6.68	7.73	7.91	7.44
	LSDX. H 0.42			LSD x 0.24
	6.56	7.00	7.10	
LSDH			0.24	

3.7. The Leaves Content of Iron mg.kg^{-1}

The results in Table (7) showed that spraying with yeast suspension caused a significant increase in iron by increasing the added concentration, as it reached the highest value 114.63 mg.kg^{-1} for x2 with significant increased compared to x1 and x0 (96.6, 88.29) mg.kg-1 respectively . also we note in the same table increase of iron in the leaves with an increase in the concentrations of the added nutrient where where h2 gave the highest values was 115.35 mg.kg-1 while h1 and h2 gave the lowest (103.61, 80.85) mg.kg-1 respectively. As a result of the interaction, the iron increased reached to highest value(131.69) mg.kg^{-1} for x2,h2 While iron appeared in the lowest values 76.22 for the treatment h0x0.

Table 7. Effect of spraying yeast suspension , nutrient solution and their interaction on the content of iron in the leaves mg.kg^{-1}

	H			
x	**H0**	**H1**	**H2**	**Mean X**
X0	76.22	92.34	86.03	88.29
X1	80.31	92.34	118.05	96.90
X2	86.03	126.16	131.69	114.63
	LSDX. H 5.98			LSD x 3.45
	80.85	103.61	115.35	
LSDH			3.45	

3.8. The Leaves Content of Zinc mg.kg^{-1}

The zinc element was affected by the research treatments, like the rest of the elements, from the results are shown in the table (8) there is a significant increase in this element occurred by increasing the concentration of the added yeast suspension where x2 gave highest value 28.42 mg.kg-1 with a significant difference compared to x0 was(23.34) mg.kg-1 , In the same field, the spraying treatments with the nutrient solution increased zinc content significantly where h2 gave highest values (29.33) mg.kg^{-1} followed by h1 was 27.13 mg.kg^{-1} while the h0 spray treatment gave the lowest values (20.09) mg.kg-1 . As a result of the interaction of yeast suspension with the nutrient solution, the treatment x2 , h2 was given highest zinc value 33.12 mg.kg-1 While the lowest value of zinc was 18.46 mg.kg-1 for the treatment h0x0.

Table 8. Effect of spraying yeast suspension , nutrient solution and their interaction on the content of zinc in the leaves mg.kg^{-1} .

	H			
x	**H0**	**H1**	**H2**	**Mean X**
X0	18.46	25.13	21.03	23.34
X1	20.77	25.13	28.44	24.78
X2	21.03	31.12	33.12	28.42
	LSDX. H 1.44			LSD x 0.83
	20.09	27.13	29.33	
LSDH			0.83	

The increase in the content of elements in the leaves For spray treatments with nutrient solution and yeast suspension may be due to what these solutions contain of macro elements represented by nitrogen, phosphorous, potassium, magnesium and micro elements, namely iron, zinc, copper and manganese, which have a role in increasing the efficiency of photosynthesis. Where Nitrogen and magnesium are included in the structure of the chlorophyll ,also Iron increases the activity of photosynthesis enzymes , And manganese has an important role in increasing the absorption of other elements such as nitrogen and potassium As well as phosphorous enters in the synthesis of ATP and ADP, thus increasing the division and elongation of cells It reflects positively on the vegetative growth of seedlings, On the other hand, these solutions work to increase the activity of the root system and its efficiency, due to increases its absorption for the elements from the soil [18]. The above results are in agree with[19], as he showed that the foliar spraying of orange trees with nitrogen, magnesium and zinc caused an increase in the content of the leaves from these elements and an increase in chlorophyll[20,8], they found Foliar spraying with yeast suspension and the nutrient solution containing many elements which increased the concentrations of the elements in the plant finally lead to vegetative growth improvement.

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