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Root growth of citrus rootstocks (sour orange and Volcamriana) affected by foliar nutrition with coconut liquid and dry yeast extract

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Abstract:

This study aimed to improve the root growth indicators of the citrus rootstock (Volcamriana and sour citrus) by spraying them with coconut liquid extract and yeast extract. The experiment was carried out using the Randomised complete blocks design (R.C.B.D) as a factorial experiment with three factors :the citrus rootstock (sour orange and lemon Volcamriana) and the extract of coconut liquid with three concentrations (0 ,100 ,200) ml .L^{-1} and dry baking yeast extract in three concentrations (0 ,4 ,8)g.L^{-1} with three replicates .At the end of June of 2023 the measurements were taken and the results were analyzed according to the statistical design used ,and the averages were compared according to the selection of the least significant difference and at the level of probability ,0.05 and the most important results reached: rootstock Volcamriana excelled in the studied root qualities (root length, root diameter, root size , dry weight of root group) while the treatment of coconut liquid 200 ml L^{-1} and the treatment of dry yeast extract at a concentration of 8 g L^{-1} achieved significant superiority for the studied qualities (root length , root diameter , root size , dry weight of the root group) By giving it the highest averages. The treatment of the binary interaction between (rootstock Volca mriana + coconut liquid 200 ml L^{-1}) and treatment (rootstock Volca mriana + dry baking yeast extract at a concentration of 8 g L^{-1}) and treatment (coconut liquid 200 m .L^{-1} + dry baking yeast extract at a concentration of 8 g L^{-1} are the highest averages in the root qualities studied.The triple overlap treatment gave (rootstock Volca mriana + coconut liquid 200 ml L^{-1} + dry baking yeast extract at a concentration of 8 g L^{-1} significantly excelled in the majority of the studied growth qualities (root length , root diameter , root size , dry weight of the root group) .

Keywords: foliar nutrition , sour orange , Volcamriana , root diameterand length

Introduction

Citrus fruits are evergreen fruit trees ,which belong to the family Rutaceae and includes several genera that are characterized by the presence of oil glands with an aromatic smell in most parts of the plant that distinguish them from the rest of the other types of fruit ,and are widely cultivated in tropical and subtropical areas around the world on a commercial scale [1,2] . The citrus group is considered one of the economically important fruit groups ,citrus fruits are famous for their nutritional value ,quality , aroma and attractive flavor as their fruits are rich in mineral salts necessary for building the human body , moreover , they are an important source of vitamin C , dietary fiber ,carbohydrates and minerals [3] .

It also contains vitamin A , B1 and B2 [4] .The cultivation of citrus fruits in Iraq faces many problems especially in the central and southern region ,including the slow growth of seedlings and trees , and highlights the problem of low success rate of seedlings planted in the field as one of the factors that cause great losses to farmers , so seedling producers are working to increase and improve the growth strength of these seedlings so that they are in a healthy and nutritional condition high in their content and performance to help them pass the stage of effort that they are exposed to during transportation and cultivation .Agricultural production is an essential element of national income and Arab food security ,which can be increased through horizontal and vertical expansion using good varieties and following modern scientific methods that come to the forefront ,including providing care in the propagation of citrus seedlings to produce seedlings with strong growth ,so commercial varieties of citrus fruits are propagated by grafting them on the appropriate assets produced by seeds ,and due to the fact that the tree depends in its basic construction on the origin ,which represents its root group ,Citrus origins are part of trees directly related to crop adaptation to biotic and abiotic conditions ,and have become a key factor in the current era of climate change[5] .It was known that the asset has an impact on the characteristics of several of the variety grafted on it including the shape ,size and nature of tree growth and the age of onset of pregnancy , production and endurance of environmental factors of soil and climate and for widespread diseases ,so the attention must be focused on improving the growth of assets in quantity and quality [6].The use of assets in citrus fruits leads to an increase in the quality of the fruit ,including sour orange due to the advantages provided by this origin [7] .Volcamriana lemon is one of the origins of citrus that is widely used in important citrus growing areas in the world .This root is characterized by high specifications that have a positive effect on the growth of grafts and is compatible with most types of citrus [8].The importance of these assets must pay attention to the methods of propagation and breeding. Natural extracts ,including coconut liquid , have been used to increase the growth of many plants to reduce chemicals and their high content of nutrients ,amino dams and plant hormones .Coconut water is referred to as the" fluid of life "because it is a source of many nutrients and minerals and is low in sugars and calories ;rich in vitamins [9].

Biostimulants drew attention to plants and in the past few decades ,they later became a positive alternative to chemical fertilizers .These tend to reduce severe environmental pollution [10,11]. Baker's yeast Saccharomyces cerevisiae is a non-pathogenic unicellular fungus with a high growth rate .Bread yeast showed the ability to raise the values of germination and growth indicators of wheat seedlings [12].It can be easily manipulated in the laboratory because its genome is fully sequenced .It is a very characteristic yeast to promotes growth and is available for different crops . It can play a useful role in cell division and enlargement [13,14]. Therefore ,this study aimed to improve the root growth indicators of the citrus rootstock (Volcamriana and sour citrus) by spraying them with coconut liquid extract and yeast extract to find the best concentration and optimal combination and reduce the time required for their stay in the nursery and deliver them to the stage of sale and grafting of other citrus species.

Materials and Methods

The experiment was carried out in the canopy of the Horticulture and Landscape Department / College of Agriculture / University of Kerbala in the district of Husseiniya for a period of time from 15/2 to 1/7 to study the effect of spraying with coconut liquid and dry baking yeast extract on the growth of the citrus rootstock. 270seedlings of the citrus rootstock (sour orange and lemon Volcamriana) at the age of six months and homogeneous as possible in size and vegetative growth and planted in polyethylene bags of 1.25 kg were taken.The seedlings were transferred on 3/2 to perforated plastic containers from the bottom with a capacity of 10 kg filled with sandy loam soil mixed with peat moss in a ratio of 1:3 . After the completion of the transfer of seedlings , they were distributed randomly and the canopy floor was covered with polyethylene to prevent the growth of weeds and bushes .Service operations were carried out equally for all transactions treatments.the next morning the seedlings were sprayed with three concentrations of coconut liquid (0,100,200) ml L^{-1} and three dry bread yeast extract (0,4,8) g $\cdot L^{-1}$, on the same day, where aqueous solutions of coconut liquid were prepared by taking a certain number of coconut fruits and were pierced by a spiral machine (Al-Breena) after that was filtered by a cloth of the restless and took from it the above concentrations and completed the volume to liters.The extract of dry baking yeast prepared according to concentrations (0,4,8) g $\cdot L^{-1}$ dissolved in a little warm distilled water at 35 C° and sugar at a concentration of 0.5g $\cdot L^{-1}$ for 24 hours.The purpose of adding sugar is to increase the activity of yeast and supply it with energy [15] .The volume was completed to litter according to the mentioned coefficients [16] .The seedlings were sprayed until completely six sprays between one spray and the next, two weeks apart starting from 15/2/2023 to 1/7/2023.

Design and statistical analysis

The experiment was designed according to the design of the complete random sectors (R.C.B.D) as a factor experiment with three factors : The first citrus rootstocks (sour orange and lemon Volcamriana) ,scond factor coconut liquid extract with three concentrations of (0,100,200)ml L^{-1} and the third factor dry baking yeast extract in three concentrations (0,4,8) g. L^{-1} and three repeaters containing 18 seedlings each

and 5 seedlings per treatment ,thus bringing the number of seedlings to 270 seedlings, and the averages were compared according to the selection of the lowest significant difference L.S.D and at the level of probability 0.05 [17] The measurements were taken at the end of June of2022 and the following characteristics were measured:

traits of root growth :-

1. **root length (cm)**

   The length was measured from the growing apex area of the main root to the crown area ,then calculate an average and then calculate the average of 5 plants from each experimental unit.

2. **Root size (cm^3)**

   The size of the root total of the seedling was measured using a cylinder graduated with a known volume of water and according to the displacement for an average of 5 plants from each experimental unit.

3. **Root diameter (cm)**

   It was calculated according to the following equation

$$D=2\sqrt{\frac{V}{L}}\times\pi$$

   Where D is the root diameter cm ,V is the root size cm^3 , L is the root length in cm , π the straight ratio is 7/22

4. **Root group dry weight (g)**

   After extracting the seedlings from the planted bags ,the vegetative total was separated from the root system from the swollen crown area of the citrus seedlings ,and the roots were washed with water and placed in perforated paper bags in an electric oven with a temperature of (70 C°) and until the weight is stable and then weighed with an electric sensor balance.

Results and Discussion

Root length (cm)

The results in Table (1) show that there is a significant impact for the rootstock type in the average root length with the superiority of the rootstock Volcamriana by giving it the highest average of 45.839 cm compared to the rootstock sour orange by giving an average of 42.061 cm and an increase of 8.982% . It was found that there is a significant effect for treatment with coconut liquid, as the highest average of the studied trait was achieved at a concentration of 200 ml L^{-1} amounted to 52.568 cm compared to the control treatment by achieving the lowest average of 35.208 cm with an increase of 53.899%, and the results also show the significant effect of yeast extract with a concentration of 8 g L^{-1} with the highest average of the trait of 47.319 cm compared to the treatment of The control that achieved the lowest average of 40.634 cm with an increase of 16.451%.

As for the bilateral interference between the type of rootstock and coconut liquid, the treatment of the rootstock Volcamriana and coconut liquid 200 ml L^{-1} achieved the highest average trait of 54.571 cm compared to the treatment of rootstock sour orange and coconut liquid 0 ml L^{-1} by giving it the lowest average of 33.999 cm and an increase of 60.507% . As for the overlap between the type of rootstock and the yeast extract, the treatment of rootstock Volcamriana and yeast extract at a concentration of 8 g L^{-1} achieved the highest rate of 48.876 cm compared to the treatment of rootstock sour orange and yeast extract 0 g L^{-1} by giving it the lowest average of 38.494 cm and an increase of 26.970% .The results indicated a significant effect between coconut liquid and yeast extract , as the treatment of coconut liquid 200 ml L^{-1} and yeast extract 8 g L^{-1} recorded an average of 56.956 cm compared to the treatment of coconut liquid 0 ml L^{-1} and yeast extract 0 g L^{-1} with an average of 32.255 cm with an increase of 76.580%.

The results of the table showed the significant effect of the triple interference of the experimental factors in the root length characteristic , as the rootstock volcamriana interference treatment and coconut liquid 200 g L^{-1} and yeast extract with a concentration of 8 g L^{-1} achieved a high average of 57.580 cm compared to the treatment of the interference rootstock sour orange and coconut liquid 0 g L^{-1} and yeast extract 0 g L^{-1} The lowest average was 31.677 cm with an increase of 81.772%.

Table (1):Effect of rootstock,coconut liquid and yeast extract and overlap between them on average root length (cm)

Rotstock	Extract Yeast g L-1 / Coconut liquid ml L^{-1}	0	4	8	Rotstock with coconut liquid
Sour orange	0	31.677	33.353	36.967	33.999
	100	38.873	41.995	43.99	41.619
	200	44.932	50.43	56.332	50.565
Volcamriana	0	32.833	36.68	39.737	36.417
	100	43.187	47.089	49.310	46.529
	200	52.310	53.833	57.580	54.571
LSD$_{0.05}$	0.8507				0.4912
Average of yeast extract		40.634	43.897	47.319	average of the rootstock
LSD$_{0.05}$	0.00631				
Average of the rootstock with yeast extract	Sour orang	38.494	41.926	45.763	42.061
	Volcamriana	42.773	45.868	48.876	45.839
LSD$_{0.05}$	0.4912				0.2836
					Average of coconut liquid g L^{-1}
Average of coconut liquid and yeast extract	0	32.255	35.017	38.352	35.208
	100	41.030	44.542	46.650	44.074
	200	48.616	52.132	56.956	52.568
LSD$_{0.05}$	0.6015				0.3473

Root diameter (cm)

The results in Table (2) show that there is a significant effect for the rootstock type in the average root diameter with the superiority of rootstock Volcamriana by giving the highest average of 2.6317 cm compared to rootstock sour orange by giving an average of 2.5465 cm and an increase of 3.3457% .It was found that there is a significant impact for the treatment with coconut liquid, as the highest average of the studied trait was achieved at a concentration of 200 ml L^{-1} amounted to 2.6992 cm compared to the control treatment by achieving the lowest average of 2.5251 cm with an increase of 6.8947% , and the results also show the significant effect of yeast extract with a concentration of more than 8 g L^{-1} with the highest average of the trait of 2.6336 cm compared to the control treatment , which achieved the lowest average of 2.5372 cm with an increase of 3.7994%. As for the bilateral interference between the rootstock type and coconut liquid, the rootstock volcamriana and coconut liquid 200 ml L^{-1} interference treatment achieved the highest average of the trait of 2.7403 cm compared to the treatment of rootstock sour orange and coconut liquid 0 ml L^{-1}

by giving it the lowest average of 2.4630 cm and an increase of 11.2586%, while the interaction between the rootstock type and yeast extract, the treatment rootstock Volkamriana and yeast extract with a concentration of 8 g L^{-1} achieved the highest average of 2.6979 cm compared to the treatment of rootstock sour orange and yeast extract 0 g L^{-1} by giving the lowest average of 2.5031 cm and an increase of 7.782%, either coconut liquid and extract Yeast there is no moral effect.

The results of the table showed the significant effect of triple interference of the experimental factors in the root length characteristic , as the rootstock volcamriana interference treatment and coconut liquid 200 ml L^{-1} and yeast extract with a concentration of 8 g L^{-1} achieved a high average of 2.8673 cm compared to the treatment of rootstock sour orange interference and coconut liquid 0 ml L^{-1} And yeast extract 0 g L^{-1} recorded the lowest average of 2.3703 cm with an increase of 20.967%.

Table(2): Effect of rootstock , coconut liquid and yeast extract and their interaction in the average root diameter (cm)

Rotstock	Extract Yeast g L-1 / coconut liquid ml L^{-1}	0	4	8	Rotstock with coconut liquid
Sour orange	0	2.3703	2.4990	2.5197	2.4630
	100	2.4880	2.5140	2.5533	2.5184
	200	2.6510	2.6883	2.6350	2.6581
Volcamriana	0	2.6007	2.5743	2.5867	2.5872
	100	2.5037	2.5597	2.6397	2.5677
	200	2.6093	2.7443	2.8673	2.7403
$LSD_{0.05}$	0.05286				0.03052
Average of yeast extract		2.5372	2.5966	2.6336	average of the rootstock
$LSD_{0.05}$	0.02158				
Average of the rootstock with yeast extract	Sour orang	2.5031	2.5671	2.5693	2.5465
	Volcamriana	2.5712	2.6261	2.6979	2.6317
$LSD_{0.05}$	0.03052				0.01762
					Average of coconut liquid g L^{-1}
Average of coconut liquid and yeast extract	0	2.4855	2.5367	2.5532	2.5251
	100	2.4958	2.5368	2.5965	2.5431
	200	2.6302	2.7163	2.7512	2.6992
$LSD_{0.05}$	N.S				0.02158

Root size (cm^3)

The results in Table (3) show that there is a significant effect for the rootstock type in the average root size with the superiority of rootstock Volcamriana by giving it the highest average of 25.539 cm^3 compared to rootstock sour orange by giving an average of 21.976 cm^3 and an increase of 16.213% .

It was found that there is a significant impact for treatment with coconut liquid, as the highest average of the studied trait was achieved at a concentration of 200 ml L^{-1} amounted to 30.590 cm^3 compared to the control treatment by achieving the lowest average of 17.932 cm^3 with an increase of 70.588% , and the results also show the significant effect of yeast extract with a concentration of 8 g L^{-1} with a higher average trait of 26.461 cm^3 Compared to the control treatment, which achieved the lowest average of 20.996 cm^3 with an increase of 26.028% .As for the bilateral interference between the type of rootstock and coconut liquid, the treatment of rootstock Volcamriana and coconut liquid 200 ml L^{-1} achieved the highest average of the trait of 32.751 cm^3 compared to the treatment of rootstock sour orange and coconut liquid 0 ml L^{-1} by giving it the lowest average of 16.472 cm^3 with an increase of 98.828 % . As for the overlap between the rootstock type and the yeast extract, the rootstock Volcamriana treatment and the yeast extract with a concentration of 8 g L^{-1} achieved a high average of 28.717 cm^3 compared to the treatment of rootstock sour orange and yeast extract 0 g L^{-1} by giving it the lowest average of 19.476 cm^3 with an increase of 47.448% . The results indicated a significant effect between coconut liquid and yeast extract, as the treatment of coconut liquid 200 ml L^{-1} and yeast extract 8 g L^{-1} recorded an average of 34.397 cm^3 compared to the treatment of coconut liquid 0 ml L^{-1} and yeast extract 0 g L^{-1} with the lowest average of 15.917 cm^3 with an increase of 116.102%.

The results of the table showed the significant effect of triple interference of the experimental factors in the root size characteristic , as the rootstock volcamriana interference treatment and coconut liquid 200 ml L^{-1} and yeast extract with a concentration of 8 g L^{-1} achieved a higher average of 37.660 cm^3 compared to the treatment of rootstock sour orange interference and coconut liquid 0 ml L^{-1} and yeast extract 0 g L^{-1} The lowest average was 14.163 cm^3 with an increase of 165.904%

Table (3): Effect of rootstock,coconut liquid and yeast extract and their interaction on average root size (cm^3)

Rotstock	Extract Yeast g L-1 / coconut liquid ml L^{-1}	0	4	8	Rotstock with coconut liquid
Sour orange	0	14.163	16.58	18.673	16.472
	100	19.143	21.123	22.817	21.028
	200	25.123	29.034	31.127	28.428
Volcamriana	0	17.67	19.348	21.155	19.391

	100	21.547	24.55	27.330	24.476
	200	28.331	32.257	37.660	32.751
LSD0.05	0.4217				0.2435
Average of yeast extract		20.996	23.815	26.461	average of the rootstock
LSD0.05	0.1721				
Average of the rootstock with yeast extract	Sour orang	19.476	22.246	24.206	21.976
	Volcamriana	22.516	25.385	28.717	25.539
LSD0.05	0.2435				0.1406
					Average of coconut liquid g L^{-1}
Average of coconut liquid and yeast extract	0	15.917	17.964	19.914	17.932
	100	20.345	22.836	25.073	22.752
	200	26.727	30.645	34.397	30.590
LSD0.05	0.2982				0.1721

Root group dry weight (g)

The results in Table (4) show that there is a significant effect for the rootstock type in the average dry weight group root , with the superiority of rootstock Volcamriana by giving it the highest average of 17.599 g compared to rootstock sour orange by giving it the lowest average of 14.534 g and an increase of 21.088% . It was found that there is a significant impact for the treatment with coconut liquid , as the highest rate of the studied trait was achieved at the concentration of 200 ml L^{-1} amounted to 18.964 g compared to the control treatment by achieving the lowest average of 13.200 g and an increase of 43.666% , and the results also show the significant effect of yeast extract with a concentration of 8 g L^{-1} with the highest average trait of 17.112 g compared to the control treatment that achieved the lowest average of 15.082 g and an increase of 13.459%. As for the bilateral interference between the type of rootstock and coconut liquid, the treatment of rootstock Volcamriana and coconut liquid 200 ml L^{-1} achieved the highest median of the trait amounted to 20.751 g compared to the treatment of rootstock sour orange and coconut liquid 0 ml L^{-1} by giving it the lowest average of 11.856 g and an increase of 75.025% , while the interference between the type of rootstock and yeast extract has achieved treatment rootstock Volcamriana and yeast extract at a concentration of 8 g L^{-1} the highest average of 18.643 g compared to the treatment of rootstock sour orange and yeast extract 0 g L^{-1} by giving the lowest average of 13.585g and an increase of 37.232% .The results indicated a significant effect between coconut liquid and yeast extract , as the treatment of coconut liquid 200 ml L^{-1} and yeast extract 8 L^{-1} recorded an average of 19.988 g compared to the treatment of coconut liquid 0 ml L^{-1} and yeast extract 0 g L^{-1} less An average of 12.356 g with an increase of 61.767%.

The results of the table showed the significant effect of the triple interference of the experimental factors in the studied characteristic , as the treatment of the interference rootstock Volcamriana and coconut liquid 200 ml L^{-1} and yeast extract at a

concentration of 8 g L^{-1} achieved the highest average of 21.843 g compared to the treatment of interference rootstock sour orange and coconut liquid 0 mlL^{-1} and yeast extract 0 g L^{-1} as it recorded the lowest average of 11.269 g and an increase of 93.832%.

Table (4): Effect of rootstock,coconut liquid and yeast extract and their interaction on the rate of root group dry weight (g)

Rotstock	Extract Yeast g L-1 / coconut liquid ml L^{-1}	0	4	8	Rotstock with coconut liquid
Sour orange	0	11.269	11.533	12.766	11.856
	100	13.343	14.520	15.843	14.569
	200	16.143	17.253	18.133	17.177
Volcamriana	0	13.443	14.846	15.343	14.544
	100	16.430	17.333	18.743	17.502
	200	19.866	20.543	21.843	20.751
$LSD_{0.05}$	0.011264				0.006503
Average of yeast extract		15.082	16.005	17.112	average of the rootstock
$LSD_{0.05}$	0.004598				
Average of the rootstock with yeast extract	Sour orang	13.585	14.436	15.581	14.534
	Volcamriana	16.580	17.574	18.643	17.599
$LSD_{0.05}$	0.006503				0.003755
					Average of coconut liquid g L^{-1}
Average of coconut liquid and yeast extract	0	12.356	13.190	14.055	13.200
	100	14.887	15.927	17.293	16.035
	200	18.005	18.898	19.988	18.964
$LSD_{0.05}$	0.007965				0.004598

It can be see from the tables (1,2,3,4) the superiority of rootstock Volcamriana over rootstock sour orange in the studied root growth indicators, which may be due to the different nature of rootstocks growth and their response to environmental conditions according to their genetic makeup [18].

This may be due to the strong growth nature of this rootstock, which would have promoted a higher root mass in terms of length to maintain the rooting ratio and the variation in root length in the rootstock, and it may be due to the difference in genes and the behavior of each genotype [19]. It may be due to the high specifications of this rootstock and its positive effect on the growing grafts on it and its compatibility with most types of citrus , further because rootstock is responsible for absorbing water and nutrients, thereby altering tree canopy growth and photosynthesis,

providing carbohydrate storage, and adapting rootstock to certain soil conditions. This rootstock is the best in terms of characteristics compared to orange and this is consistent with what was confirmed by [20,21],where he confirmed is the best in terms of root growth qualities compared to rootstock sour orange.

Also, the addition of coconut liquid significantly affected the root growth indicators, and the reason for this may be due to the fact that coconut liquid is a source of cytokinins, which have a role in increasing the root system and its branches, which reflected positively on increasing the growth of the vegetative group of plants by increasing the plant's ability to absorb nutrients, which in turn leads to an increase in the products of photosynthesis in the manufacture of nutrients and their accumulation in the plant, which is reflected in the increase in dry matter [22] . The effect of potassium in coconut liquid has a role in transporting the products of photosynthesis to the storage parts and thus increasing their weight [23]. It contains cytokinine (Zeatin) and other hormones of auxin, gibberellins and cytokines. It may work in directing the transport of organic compounds within the plant, which stimulates genes to form proteins and chlorophyll formation, as well as Zeatin gives the plant activity, which causes increasing cell division and cytokinins in coconut water support cell division, thus promoting rapid growth [24,25],these include kinitin, which has effects on plant growth processes that can be affected by cytokinin, such as leaf expansion and seed germination [26], and these results are consistent with [27,28,29]. As for the addition of yeast extract ,it significantly affected the studied root traits ,the reason can be attributed to the effective ,large and active role of bread yeast in the production of ATP and D-Ribose energy (Vegetarian nutritional supplement) in addition to its role in increasing the production of substances that stimulate plant growth such as gibberellin ,auxin ,cytokinin ,mineral elements and amino acids ,which work on cell division and growth .The effect may be attributed to the absorption of nutrients and amino acids present in yeast extract ,which are absorbed directly by foliar cells to increase food production ,as well as increase photosynthesis efficiency leading to an increase in processed nutrients in the plant and their accumulation such as carbohydrates and protein [30] .Yeast is also a natural source of cytokinin ,which contributes to the stimulation of cell division [31]. Superiority may be attributed to the fact that yeast contains substances that promote growth such as thiamine ,niacin , riboflavin ,vitamin B12 and folic acid ,and this leads to an increase in leaf area and increased photosynthesis ,which reflects positively on the vegetative group [32]. This finding is in line with what was found by [33]. In his study on papaya trees Faten et, al ,this finding is consistent with his findings today [34]. When spraying rootstock sour orange seedlings [35], when spraying orange seedlings *Citrus limon* on the Volcamrianan rootstock [36], when spraying lemon seedlings and [37].On kumquat seedlings and [38].On the papaya plant. Rootstock Volcamriana excelled in all studied traits,while the treatment of coconut liquid 200 ml L^{-1} and the treatment of dry baking yeast extract at a concentration of 8 g L^{-1} gave significant superiority in all studied qualities. Recorded bilateral interference treatments (rootstock Volca mriana + coconut liquid 200 ml L^{-1}), (rootstock Volcamriana + dry baking yeast extract 8 g L^{-1}) and (coconut liquid 200 ml L^{-1} + dry baking yeast extract 8 g L^{-1}) the

highest averages in the studied root qualities. Triple interference treatment (rootstock Volcamriana + coconut liquid 200 ml L^{-1} + dry baking yeast extract 8 g L^{-1}) gave significant superiority in the most studied growth traits

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