The effect of spraying with a suspension of active yeast and a solution of licorice on the vegetative and flowering growth of plant *Gazania splendens* Hort.

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Abstract

The experiment was conducted in February 2023-2024, six months in the College of Agriculture, University of Basrah fabric canopy, the experiment aimed to study the effect of spraying with a suspension of active yeast and a solution of licorice on the vegetative and flowering growth of the Gazania splendens plant, the experiment included 9 factorial treatments in which two factors interacted, namely spraying leaves with a suspension of active yeast at concentrations of 0, 5 or 10g.L-1 and a solution of licorice at concentrations of 0, 10 or 15 mg.L-1, the treatment was done in three sprays, with an interval of 15 days between one spray and the next, use a Randomized Complete Block Design (R.C.B.D.) with a factorial experiment with three replicates, three plants for each experimental unit, so the number of plants is 27 plants, and using the Revised Least Significant Differences (R.L.S.D) test to compare the means at the 5% probability level, the following are the most important results reached: spraying with a suspension of active yeast at a maximum concentration of 10mg.L-1 resulted in a significant increase in plant height, number of side branches, number of leaves, number of flowers, flower diameter, and percentage of dry matter in flowers at the same time, this concentration caused a significant delay in flowering. Spraying with a licorice solution 10mg.L-1 resulted in a significant increase in plant height, number of side branches, percentage of dry matter in the shoot, number of flowers, flower diameter, and percentage of dry matter in flowers, at the same time, this concentration caused a significant delay in flowering, the binary interactions had a significant effect on all the traits under experiment. As for the study of the active substances in the plant, it showed that the number of active chemical compounds recorded in the plant extract of the untreated samples reached 33 compounds, while in the plants treated with licorice extract and the active yeast suspension, the number of compounds decreased. reaching 26 and 28 compounds, respectively.

Keyword: suspension active yeast, licorice, vegetative, Gazania splendens, Active compounds

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Introduction

The Gazania splendens plant belongs to the Asteraceae family and is also called the treasure flower, its original homeland is South Africa it is a perennial herbaceous ornamental plant whose height does not exceed 15cm, leaves are long, full-edged strips, their lower surface is silver in color, the leaves are lobed at the beginning of their formation, the flowers are in beautiful multi-colored inflorescences with a diameter of 7-10cm, it is characterized by the presence of black dots at the base of the orange radial florets, the plant blooms throughout the year. its flowers open during the day and close at night and in cloudy weather, therefore, it is not suitable for picking, the plant prefers sunny sites, tolerates drought and poor soil, and tolerates salinity, it reproduces by seeds and cuttings, the plant is grown in different locations in the garden, such as flower beds, for selection, or as anvil plants, and it can be planted mixed with other flowering plants, to increase plant growth and complete flower formation and quality, the importance of foliar feeding on the vegetative parts is highlighted due to the latter having the ability to absorb mineral substances to varying degrees and thus obtaining a quick and effective response from the plant [1 .[

The process of absorption of nutrients by foliar spraying goes through stages represented by the process of wetting the surface of the vegetative part with the nutrient solution, which leads to an increase in the swelling pressure of the guard cells, so the stomata open and the cuticle layer becomes more permeable and absorbs nutrients through small channels present in the cuticle layer called Ectodesmata, and they are absorbed by entering the cuticle layer, Apoplast is considered an important passageway for nutrients before they are absorbed by the plasma membrane, which the nutrients reach after penetrating and crossing the outer epidermis of the cell wall and are absorbed into the living part of the plants [2,3 .[

Foliar feeding is used on the vegetative parts as a result of the latter having the ability to absorb mineral substances in varying degrees and thus obtaining a quick and effective response from the plant [1.[

Study [4] of the response of G. splendens to seaweed extract (Ticamine algae) and nanoparticles the stimulant (Protec Calpur) and its effect on vegetative and flowering growth (plant height, number of leaves, dry weight, chlorophyll and carbohydrate content of leaves, number of flowers, their weight and diameter), as an increase was observed in all the studied plant indicators.

The effect of silicon and humic acid on the vegetative and flowering growth of G. splendens plant studied by [5] used four concentrations of silicon (0, 75, 150, 300 mg.L-1) and humic acid (0, 50, 100, 150 mg.L-1), the results were observed as a significant increase in vegetative growth when using silicon, represented by the height and diameter of the plant, the number of leaves and branches, wet weight and root growth. Humic acid had a significant effect on the total number of vegetables, and the two concentrations (100 and 150 mg.L-1) gave the highest increase in plant height. plant diameter, the number of leaves, wet weight of vegetative growth, and concentration, treatment with humic acid also led to improved flowering.

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[6] stated that yeast contains many important nutritional elements for plants, and [7] explained that spraying with a yeast suspension at a concentration of (7.5, 5.0, and 0) g.L-1, with a concentration of 5 g.L-1, gave the highest results in the studied vegetative traits, [8] obtained a significant increase in the number and diameter of flowers of Tagetes erecta when sprayed with a dry yeast suspension at a concentration of 4 g. L-1

[9] confirmed that spraying licorice extract at a concentration of 5 g.L-1 on Ruscus sp, there was a significant increase in the number of branches, branch length, number of leaves on the branch, leaf length, and leaf area, the results of [7] confirmed that spraying licorice extract on the sorcery plant at a concentration of 4g.L-1 led to a significant increase in plant height, the number of main branches, and dry weight, for the vegetative group and significant increase in the number of flowers, the diameter of the flower stalks, and the flowering age. [9] also found that spraying licorice extract at a concentration of 4 g.l-1 on clove plants led to a significant increase in the number of flowers, number of petals, flower diameter, and flower stem diameter .

Materials and Methods

The experiment was conducted in the agricultural season 2023-2024 in February for a period of six months in the fabric canopy of the garden unit at the College of Agriculture-University of Basrah. The experiment aimed to study the effect of spraying with active yeast suspension and licorice solution on the vegetative and floral growth of Gazania splendens plants. 27 plants were brought and rotated in pots with a diameter of 12 cm after being filled with an agricultural mixture at a ratio of 2:1 of agricultural seeds and peat moss, at a rate of one plant per pot.

Prepare aqueous solutions of yeast and licorice suspension

The experiment was implemented according to a completely randomized block design and a factorial experiment that included 9 treatments an interaction factor involving two factors: foliar spraying with an active yeast suspension at concentrations of 0, 5, or 10 mg.L-1 and a licorice solution at concentrations of 0, 10, or 15 mg. L-1 and three replicates for each treatment, so the number of experimental units is 27 experimental units.

Prepared aqueous solutions of both the yeast suspension and a licorice solution extracted from the Glycyrrhiza glabra plant in the required concentrations, and a few drops of Tween-20 were added to each of them. The plants were then sprayed on the leaves a month after rotating them, using a hand sprayer, until they were completely wet, at an average of three sprays during the growing season .

Experimental measurements

-1Vegetative growth indicators

All experimental measurements of vegetative growth indicators were taken when the plant reached the stage of full flower opening on experimental plants and included the following characteristics: The height of each plant in the experimental unit was measured from the soil surface to the top of the plant using a tape measure and calculated the total number of leaves for each plant in the experimental unit and recorded their average, and after taking the fresh weight of the shoots

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of the plants after separating them from the roots, they were then placed in paper bags in an electric oven at a temperature of 70°C for 48 hours until the weight was constant, then their weight was recorded and the percentage of dry matter was calculated according to the following equation :

Dry weight of shoots (g(

Percentage of dry matter of shoots % = × 100

Fresh weight of shoots (g(

-2Floral growth indicators

The number of days required from seed sowing until the first flower opened for each plant of the experimental unit was calculated and according to the number of blooming flowers in each plant of the experimental unit, Flower diameter (cm): the diameter of three flowers formed on each plant of the experimental unit taken at full bloom was measured cross-wise using a Vernea foot and their average was recorded .

Percentage of dry matter in flowers (%): Three flowers were taken randomly from each plant of the experimental unit and their fresh weight was recorded, they were placed in paper bags in an electric oven at a temperature of 70°C for 48 hours until the weight was constant, then their weight was recorded and the percentage of dry matter was calculated according to the following equation:

Dry weight of flowers (g(

Percentage of dry matter of flowers % = x 100

Fresh weight of flowers (g(

Results and discussion

It is noted from Figure (1) that spraying plants with a suspension of active yeast achieved a significant increase in plant height at a concentration of 10 mg.L-1 gave the highest plant height of 11.78 cm, compared to the comparison treatment, which gave the lowest height of 10.11cm. this increase may be due to the active yeast suspension containing the element potassium, which is an osmotic regulator that has an influential role in the process of opening and closing stomata, which is reflected in the increased absorption of water and nutrients that activate the photosynthesis process and increase its products and their effect on cell elongation and division, which leads to increased height, the plant [10], and spraying with a licorice solution had a significant effect on the height of G. splendens at a concentration of 15 mg.L-1 gave the highest plant height of 11.28cm, compared to the control plants, which reached 10.50 cm. the reason is due to the nitrogen contained in the licorice solution, which has a role in the synthesis of proteins it is noted from the same table that the spraying treatmen

ts and it appears from the same table that bilateral interaction between the active yeast suspension and the licorice solution had a significant effect on this trait, as the plants sprayed with the licorice solution at a concentration of 15mg.L-1 and yeast suspension at a concentration of 10 mg.L-1 the highest height was 12.50 cm compared to the

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lowest height of 8.17 cm resulting from the control plants

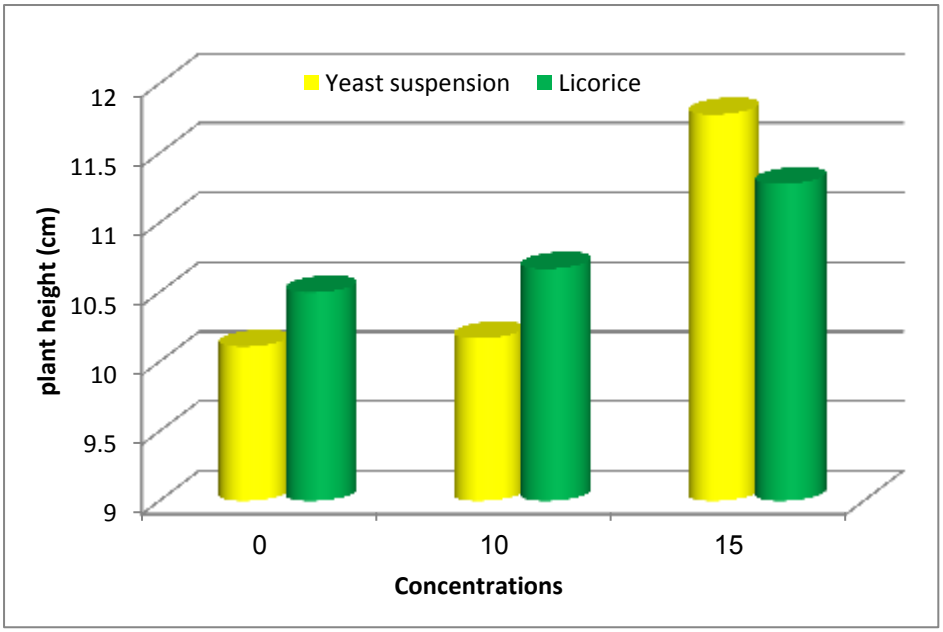

Fig (1): Effect of spraying with licorice solution and active yeast suspension on the height of G. splendens

It is noted from Figure (2) that spraying plants with a suspension of active yeast has a significant effect on the number of leaves per plant, as the number of leaves increased in plants sprayed at concentrations of 5 and 10 mg.L-1, which did not differ significantly from each other as it reached 62.80 and 60.90 leaves, respectively, compared to the comparison treatment, which gave the lowest number of 35.00 leaves, this may be attributed to the content of the yeast suspension with nutritional elements such as nitrogen, phosphorus, and potassium, as well as some growth regulators and multiple amines that lead to improved vegetative growth, and this is reflected in the phenotypic characteristics, including an increase in the number of leaves [11]. This is consistent with what [12] found on the freesia plant. It is noted from the same table that spraying with a licorice solution had a significant effect on the number of leaves of the G. splendens plant when a Concentration 15 mg.L-1 gave the plant the highest number of leaves, reaching 65.30 leaves, compared to the comparison plants, which amounted to 40.00 leaves. This increase may be due to the content of potassium humate in the licorice solution, which has a physiological effect very similar to that of cytokinin, which has the effect of encouraging plant growth [13]. It appears from the same table that the bilateral interaction between the active yeast suspension and the licorice solution had a significant effect on this trait, as it gave the plants sprayed with the yeast suspension 10 mg.L-1 and the licorice solution at a concentration of 15 mg. L-1: The largest number of leaves per plant reached 82.30 leaves, compared to the lowest number of 29.00 leaves resulting from the control plants

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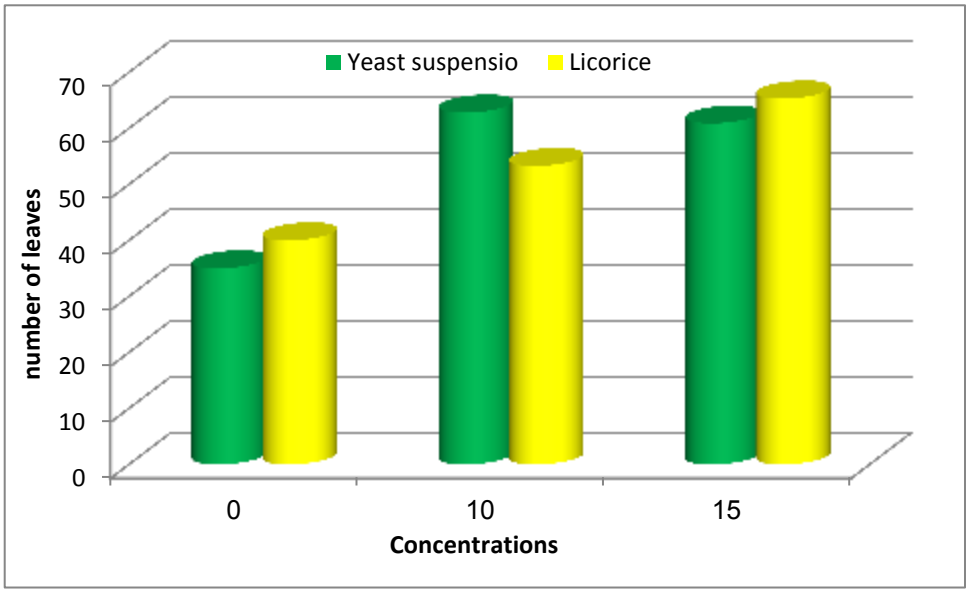

Fig (2): The effect of spraying with licorice solution active yeast suspension on the number of leaves of G. splendens

Note from Figure (3) the plants that were sprayed with a suspension of active yeast at concentrations of 5 and 10 mg.L-1 had a significant increase in the percentage of dry matter of the vegetative total, which did not differ significantly between them as it reached 9.95 and 9.30%, compared to the comparison treatment with the lowest percentage reaching 8.37%. This may be attributed to the fact that the active yeast suspension works to provide a portion of the nitrogen needs of the plant and contributes to building protein inside it by containing free amino acids, it also helps improve the efficiency of photosynthesis processes inside the leaf and this is consistent with what was found by [14]. It is noted from the same table that the plants sprayed with licorice solutions at concentrations of 10 and 15 mg.L-1 excelled in this characteristic, reaching 9.83 and 9.14% compared to the comparison plants, which amounted to 8.65%, this increase may be attributed to the potassium content of licorice, which has an important role in accelerating the process of transporting all manufactured materials to storage sites[15]. It appears from the same table that the binary interaction between the yeast suspension and the licorice solution was significant in this characteristic, as the plants sprayed with the yeast suspension with a concentration of 10mg.L-1 and the licorice solution with a concentration of 15mg.L-1 had the highest percentage of 11.68% compared to the lowest percentage of 7.36 produced by the control plants.

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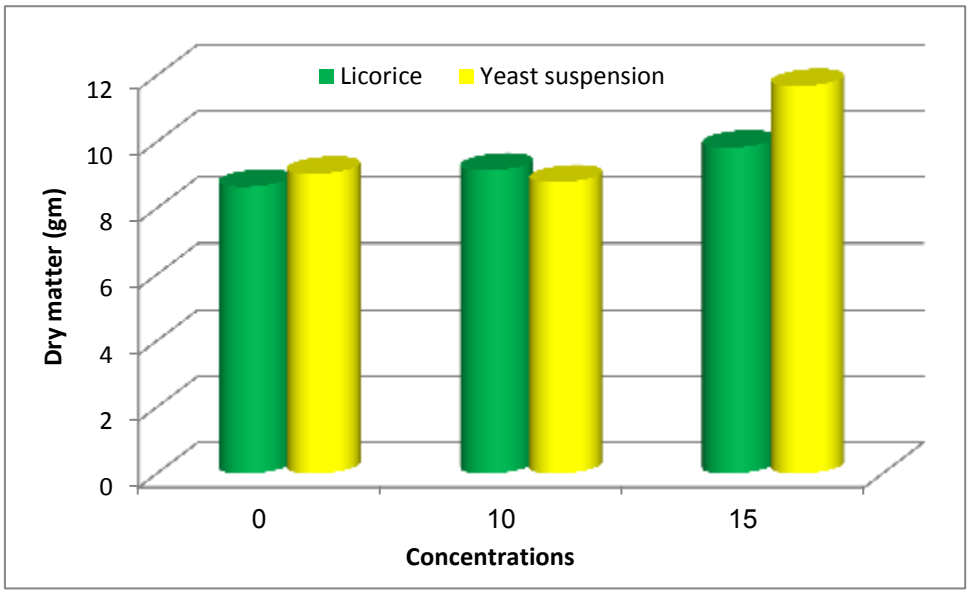

Figure (3). The effect of spraying with yeast suspension and licorice solution on the percentage of dry weight of the vegetative total of G. splendens

We note from Figure (4) that spraying the plants with a yeast suspension of 10 mg.L-1 led to a significant delay in the flowering date, reaching 103.00 (days after planting), compared to the control plants, which reached 109.2 (days after planting), it is noted from the same table that spraying the plants with a licorice solution concentration of 15 mg.L-1 led to a significant delay in flowering time by 101.6 (days after planting) compared to the control plants, which amounted to 112.1 (days after planting), the reason is that plants are equipped with NPK elements necessary for their growth, and this is reflected in improving the growth of the shoots and thus increasing photosynthesis, which leads to earlier flowering, it is noted from the same table that the two-way interaction between the experimental factors had a significant effect on this trait, as the plants sprayed with the yeast suspension, concentration of 10 mg.L-1, and the licorice solution, concentration of 15 mg.L-1, were earlier at the time of flowering, reaching 98.00 compared to the control plants. It reached 123.3 day after planting

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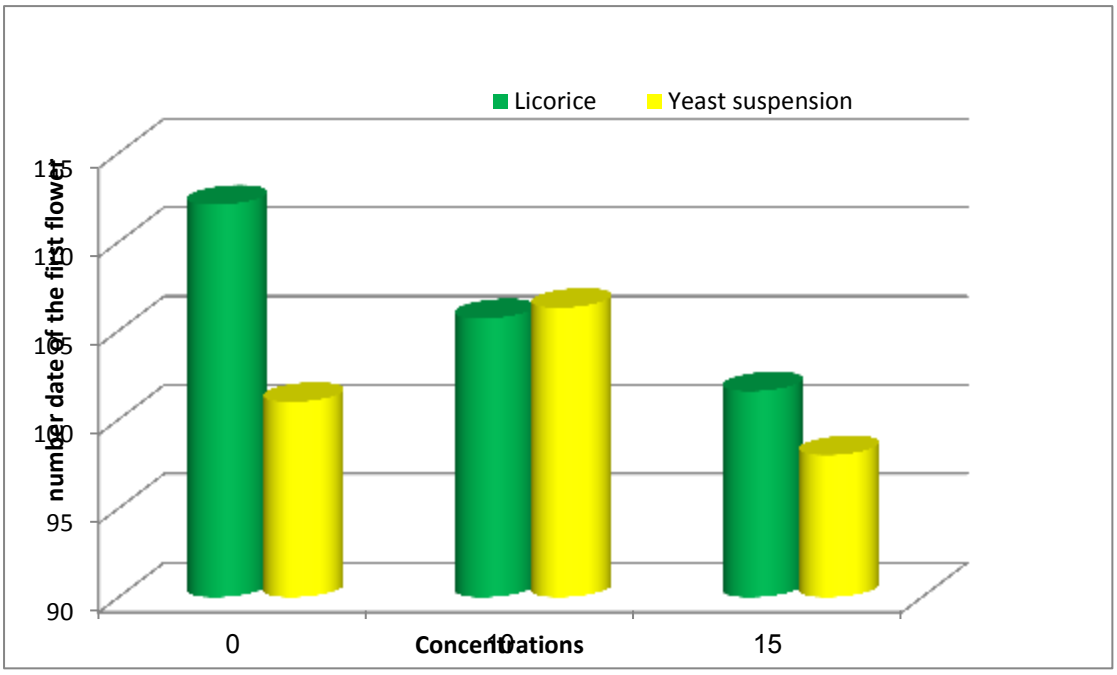

Fig. (4). Effect of spraying with yeast suspension and licorice solution on the opening date of the first flower of G. splendens (day(

We note from Figure (5) that the plants were sprayed with a yeast suspension with a concentration of 10 mg.L-1 led to a significant increase in the number of flowers (flower, plant), reaching 13.89 compared to the control plants, reaching 6.67, the reason for the increase in the number of flowers in the plant is due to the components of the yeast suspension and the nutrients it contains, including iron and manganese, and their role in the process of photosynthesis and energy-rich compounds, thus increasing the production of nutrients within the plant, which leads to encouraging plant growth and increasing the number of flowers [8]. It is noted from the same table that spraying plants with a licorice solution of 10 or 15 mg.L-1 did not differ significantly from each other in the number of flowers, as they reached 13.33 and 10.00 flowers, but they were significantly superior to the comparison plants, which reached 5.44 flowers, plant The reason for spraying a licorice solution providing the plants with the NPK elements necessary for their growth was reflected in improving the growth of the vegetative system and thus increasing photosynthesis, which led to an increase in the number of flowers it is noted from the same table that the binary interaction between the experimental factors had a significant effect on this trait, as the number of flowers increased in the plants that were sprayed with the yeast suspension, concentration of 10mg.L-1, and the licorice solution, concentration of 15mg.L-1, reaching 16.67 flowers. Plant compared to comparison plants, which reached 1.67 flowers. plants.

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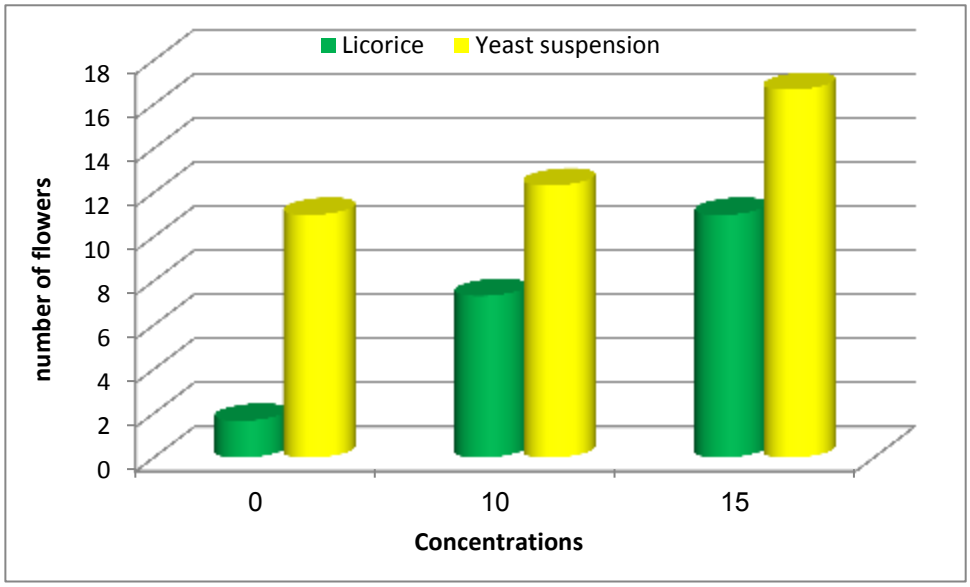

Fig. (5). The effect of spraying with yeast suspension and licorice solution on the number of flowers of the G. splendens plant

We note from Figure (6) that spraying the plants with a yeast suspension concentration of 10 mg.L-1 led to a significant increase in the diameter of the flower, reaching 7.70cm compared to the control plants, which was 6.83cm, the reason for increasing the diameter of the flower is due to the role of natural extracts in providing natural stimulants such as amino acids, proteins, and cytokinins, which encourage cell division and elongation, which is reflected in increased growth represented by an increase in the diameter of the flower [16]. It is noted from the same table that spraying the plants with a licorice solution concentration of 15 mg.L-1 led to a significant increase in the diameter of the flower by 7.50cm, compared to the control plants, which reached 6.95cm, the reason may be that spraying licorice provides plants with the necessary NPK elements for growth, which leads to improved shoot and root growth and thus increases the amount of carbohydrates accumulated in plant tissues, which in turn prompts plants for good flowering growth [17]. It is noted from the same table that the binary interaction between the experimental factors had a significant effect on this trait, as the flower diameter of the plants sprayed with the yeast suspension, concentration of 10 mg.L-1 and the licorice solution, concentration of 10 mg.L-1, increased to 7.93 cm compared to the control plants. Which reached 6.03 cm .

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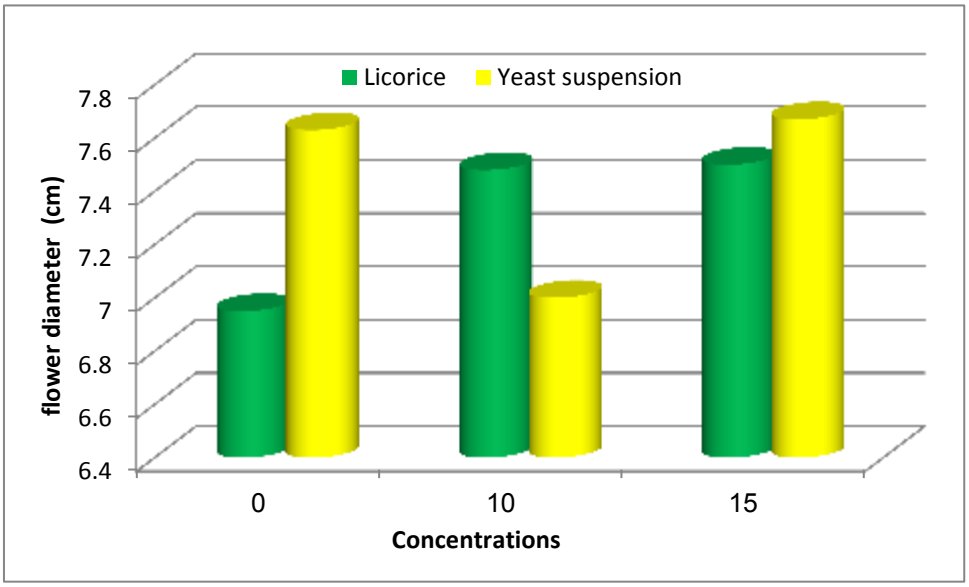

Fig. (6). Effect of spraying with yeast suspension and licorice solution on flower diameter of G. splendens (cm)

The results in Table (1) showed that spraying plants with yeast suspension at a concentration of 10 mg.L-1 led to a significant increase in the percentage of dry matter, reaching 15.71% compared to the plants that were sprayed at a concentration of 5 mg.L-1 and the control plants, which did not differ significantly in terms of Between them, they reached 12.32 and 12.28%. The reason for Increase in the percentage of dry matter of flowers may be due to the role of active yeast in the content of compounds necessary to encourage growth and the manufacture of carbohydrates and their accumulation in the flowers, as they are a center of attraction for nutrients [11]. It is noted from the same table that spraying plants with a licorice solution for flowers led to a significant increase in the percentage of dry matter of flowers with a concentration of 15 mg.L-1, reaching 14.80%, compared to the control plants, which reached 12.50%. The reason may be that spraying the licorice solution provides the plants with the NPK elements necessary for growth, which leads to improved shoot and root growth and thus increases the amount of carbohydrates accumulated in the plant tissues [17]. It is noted from the same table that the two-way interaction between the experimental factors had It had a significant effect on this trait, as the percentage of flower dry matter increased for plants sprayed with yeast suspension, concentration of 10 mg, licorice extract at a concentration of 15 mg.L-1 gave the highest values, 18.61%, compared to the comparison treatment.

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Table (1). The effect of spraying with yeast suspension and licorice solution on the percentage of flower dry matter of G. splendens plants(%)

Licorice average	effect	Yeast suspension gm.l^{-1} 10	5	0	**Licorice mg.L^{-1}**
12.50		13.66	12.68	11.17	**0**
13.02		14.86	12.76	11.45	**10**
14.80		18.61	11.53	14.24	**15**
1.52		2.63			**L.S.D**
		15.71	12.32	12.28	**Effect average of yeast suspension**
		1.52			**L.S.D**

As for the chemical study of G. splendens, it showed that the number of active chemical compounds recorded in the plant extract of untreated samples was 33 compounds, while in plants treated with licorice extract and active yeast suspension, the number of compounds in them decreased, reaching 26 and 28 compounds, respectively, exposure of any plant to any additives or treatments, such as fertilizers, stimulant extracts, or nutrients, leads to a significant increase in reactive oxygen species, which causes great pressure inside the plant cell and thus leads to the destruction of the structural structure of protein, DNA, ribonucleic acid (RNA), and cellular membranes due to increased lipid peroxidation. , which leads to disturbances in the photosynthesis process, and thus leads to a defect in the plant and its by-products. Therefore, we notice the disappearance of many active compounds in the plant, or their concentrations decrease, or the production of new compounds in It [18]. (Table, 2 and Figure, 7 ,8.(

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Table (2): Active chemical compounds in the G. splendens plant

Name	Formula	cont.	Yeast suspension	licorice
.beta.-D-Glucopyranose, 1-thio-,1-[N-hydroxy-5-(methylthio)pentanimidate]	C12H23NO6S2	2.4831	1.6545	1.4981
Hexadecanoic acid, ethyl ester	C18H36O2	0.5310	0.8627	0.6452
1,2-15,16-Diepoxyhexadecane	C16H30O2	0.5881	0.6807	0.6510
1,9-Dioxacyclohexadeca-4,13-diene-2-10-dione, 7,8,15,16-tetramethyl-	C18H28O4	0.6363	0.8382	0.6647
13,16-Octadecadiynoic acid, methyl ester	C19H30O2	0.3591	0.2907	0.2888
12-Hydroxy-14-methyl-oxa-cyclotetradec-6-en-2-one	C14H24O3	0.5213	0.4118	
1-Ethynyl-3,trans(1,1-dimethylethyl)-4,cis-methoxycyclohexan-1-ol	C13H22O2	2.1074	1.9165	1.9938
1-Heptatriacotanol	C37H76O	0.3610	0.1542	0.6455
1,25-Dihydroxyvitamin D3, TMS derivative		152.658	50.266	77.6753
2,2-Dimethyl-3-vinyl-bicyclo[2.2.1]heptane	C11H18	0.4087		0.3762
5-Amino-1-benzoyl-1H-pyrazole-3,4-dicarbonitrile	C12H7N5O	0.6881	0.5467	
3-(1,3-Dihydroxyisopropyl)-1,5,8,11-tetraoxacyclotridecane	C12H24O6	0.5670	0.5390	0.5321
3,cis-(1,1-dimethylethyl)-4,cis-methoxycyclohexanol	C11H22O2	0.5781	0.9721	1.1378
3-trsns-(1,1-dimethylethyl)-4-trans-methoxycyclohexanol	C11H22O2	0.6711	0.3634	
Benzaldehyde, 4-methoxy-, oxime	C8H9NO2	0.8831	0.3597	
Bicyclo[6.2.0]decan-9-one, 10-chloro-	C10H15ClO	0.2608	0.2466	0.2411
Cyclohexanone, 2-(2-butynyl)-	C10H14O	4.7220	3.9385	3.4060
Cyclotetrasiloxane, octamethyl-	C8H24O4Si4	0.7892		
Cyclotrisiloxane, hexamethyl-	C6H18O3Si3	1.8055	0.6610	1.1279
Dasycarpidan-1-methanol, acetate (ester)	C20H26N2O2	0.5015	0.3969	0.3520
Estra-1,3,5(10)-trien-17.beta.-ol		3.5489	3.5076	
Ethyl Oleate		1.7287	1.6362	1.6548
Melezitose	C18H32O16	6.9968	11.2955	
Methyl 12,13-tetradecadienoate	C15H26O2	0.3954		0.1441
Methyl 6-O-[1-methylpropyl]-.beta.-d-	C11H22O6	12.063	12.0254	9.7409

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galactopyranoside		6		
Nonacosane	C29H60	8.2552	8.4954	8.5247
Octadecanoic acid	C18H36O2	4.8113	2.5921	2.3722
Oxime-, methoxy-phenyl-_	C8H9NO2	2.0612		1.0358
Phen-1,4-diol, 2,3-dimethyl-5-trifluoromethyl-	C9H9F3O2	0.3621	1.1317	1.2454
Silane, triethyl(2-phenylethoxy)-	C14H24OSi	4.7812		0.1174
Strychane, 1-acetyl-20.alpha.-hydroxy-16-methylene-	C21H26N2O2	3.0462	4.1634	1.0735
tert-Butyldimethylsilyl trifluoromethanesulfonate	C7H15F3O3SSi	0.7338	0.8541	0.3412

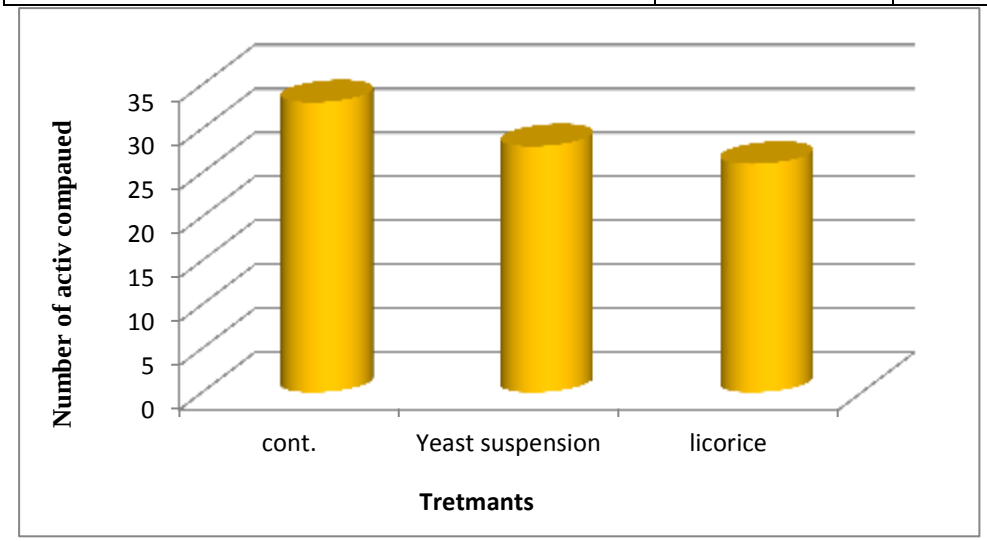
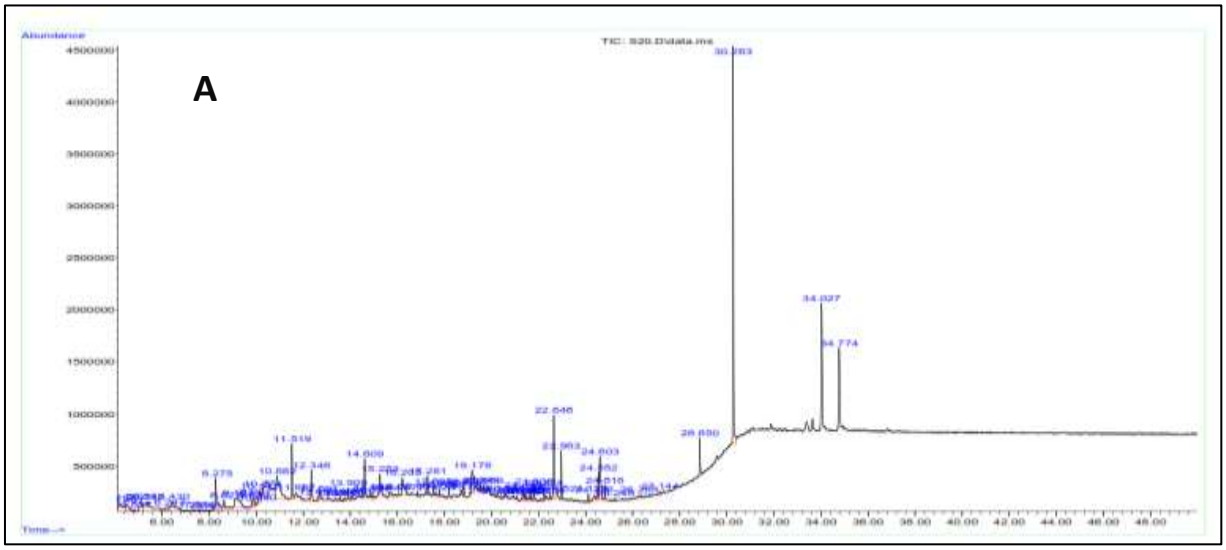


Fig. (7): The number of active chemical compounds in the G. splendens.



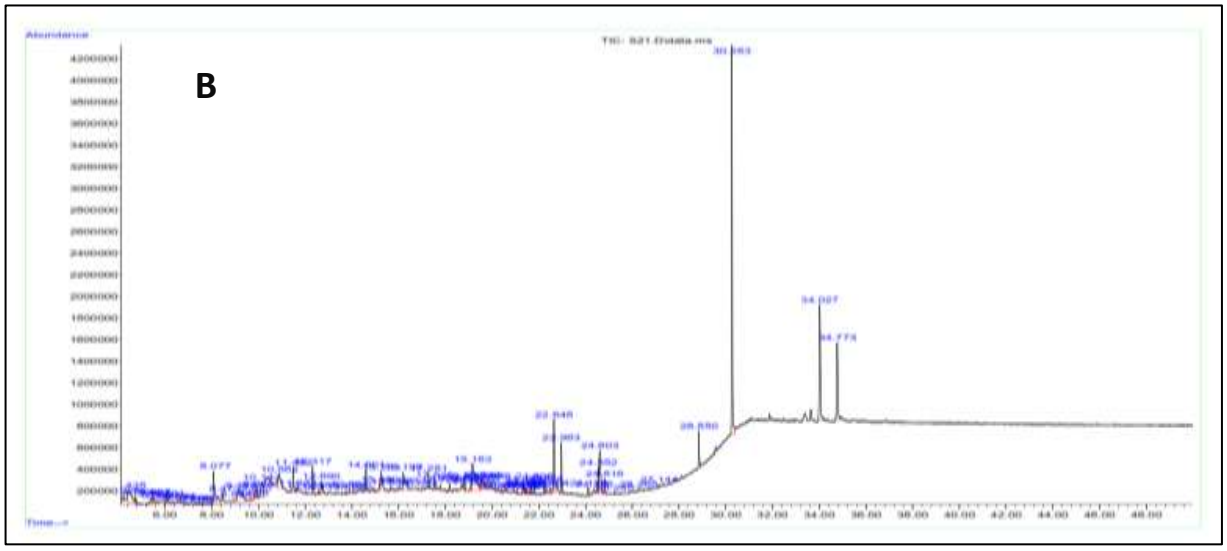


Fig. (8): Distribution of active chemical compounds in G. splendens A: Control treatment B: Yeast suspension

Conclusions

The response of G. splendens to foliar spraying with yeast suspension at the highest concentration of 10 mg.L-1 per treatment, as it led to improvement of all characteristics of vegetative and flowering growth. The response of G. splendens to foliar spraying with licorice solution at the highest concentration for all characteristics of vegetative and flowering growth. The treatments used also affected the number of active chemical compounds and their concentrations. The bilateral interaction between the two factors led to the improvement of all vegetative and floral growth indicators

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