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Effect of glutamic acid spraying and nano zinc oxide in the growth and content qualities of Lavendula Angustifolia Mill

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***Abstract*---**The study was conducted in the wooden canopy of the Department of Horticulture and garden Engineering / College of Agriculture / University of Tikrit during the 2021 agricultural season, in order to study the effect of spraying with glutamic acid and Nano-zinc oxide on some vegetative growth characteristics and mineral content of Lavendula Angustifolia Mill plant. A factorial experiment was carried out with two factors, the first factor of glutamic acid with three levels (0, 100, and 200) mg. L^{1}- The second factor is Nano zinc oxide at four levels (0, 0.50, 1, and 1.50 g). L^{1} - According to the design of the full randomized RCDB sectors (Randomized Complete Block Design) and three duplicates, the most important results are summarized as follows: Characteristics of vegetative growth: The transaction G2 was characterized by giving the highest differences in plant height, the number of leaves, and total chlorophyll content, which amounted to 32.475 cm and 876.12 leaves. $Plant^{-1}$, 35.128 mg. gm ^{1}-soft weight, respectively, compared to the lowest values for the above-mentioned traits for the comparison transaction. The transaction of Z3 spraying with Nano zinc oxide at a concentration of (1.50 g. L^{-1}) gave significant differences in most of the averages of the studied traits, which included plant height, number of leaves, and total chlorophyll content, which amounted to 32.274 cm. $Plant^{-1}$, 908.81 leaves. $Plant^{-1,}$ 36,273 mg.gm^{-1} soft weight, respectively compared to the lowest values mentioned above for the control transaction. The interaction transaction G2Z3 (spraying with glutamic acid at a concentration of 200 mg. L^{-1} + Nano zinc oxide at a concentration of 1.50 g. L^{-1}) was significantly superior in all studied traits of plant height, the number of leaves, and total chlorophyll content, which amounted to 36,180 cm, 1005.00 leaves. $Plant^{-1}$, 39.415 mg.gm^{-1} soft

weight, respectively compared to the lowest values for the above-mentioned traits for the comparison transaction. Characteristics of the mineral content**:** The transaction of G2 spraying with glutamic acid at a concentration of (200 mg/L-1) was characterized by giving the highest significant differences in the mean of most of the mineral content traits of Zn, K, and N in leaves. The Z3 transaction, spraying with Nano zinc oxide at a concentration of (1.50 $g.l^{-1)}$ gave significant differences in all the average mineral content characteristics studied above. Whereas the dual interaction transaction G2Z3 (spraying with glutamic acid at a concentration of 200 $mg.l^{-1}$ + Nano zinc oxide at a concentration of 1.50 $g.l^{-1}$) was superior in giving the highest content of nutrients N Zn, K, in the leaves, which amounted to 3.793%, 2.9630%, 41,430 $mg.l^{-1}$) respectively. Compare the lowest values of the above-mentioned attributes for the comparisontransaction.

***Keywords*---**nano-zinc, glutamic, lavender.

Introduction

Lavender plant (Lavendula angustifolia Mill or Lavendula officinalis chaix Lavendula, English name: Lavendulae Aetheroleum or Lavender), which belongs to the Lamiaceae family, is an important medicinal and aromatic plant. And the original habitat of its important commercial species is due to the mountainous regions of the Mediterranean basin countries and is grown in southern Europe, Bulgaria, Russia, and the United States of America (WHO, 2001 and Bisset, 1994),

This genus includes 48 species and more than 100 strains The plant grows well in light, fertile, well-drained soils, whose interaction degree ranges between 5.8 to 8.3and wet soils can lead to plant growth (Curtis, 2005), and the most important compounds of lavender oil are Linalyl acetate 40% and Linalol 30%, which is due to the distinctive smell of lavender (Ewais *et al.* 2005). Glutamic acid is one of the amino acids that contribute to the construction of proteins, and this is done by testing amino acids with the help of specialized enzymes and the presence of ATP to form the proteins needed by the plant as needed (Jain and Amentals, 2011). The treatment of plants with glutamic acid has been found to contribute to the construction of carbohydrates and proteins in the plant and to improve physiological traits (Saburi *et al*, 2014).

Nanotechnology or Nano science is one of the sciences that is concerned with the study of materials on the atomic scale of 10^{-9} meters, because Nanomaterial's show properties of materials that differ from them when they are in their traditional dimensions of more than 100 nanometers, Nano-fertilizers have unique features due to their small size and large surface area, which leads to an increase in the absorption surface and thus an increase in the rate of photosynthesis, which in turnincreases the production of active substances in the plant (Singh *et al.*, 2016).

Zinc is one of the main elements for growth in plants, and its absence or lack of it at the required levels negatively affects the plant, and it is a real key, regulator, andco-factor for a wide range of enzymes such as alcohol-dehydrogenase enzyme in vital processes, especially carbohydrate manufacturing processes in the process of Photosynthesis (Mengel and Kirkby, 2001).

Because of the recent research of Nano-fertilizers in Iraq, and given the importance of the plant globally and locally, and its multiple coordination, medicinal and aromatic uses, and with the aim of testing the extent of its cultivation under the conditions of Salah al-Din Governorate, the current study aimed to:

1. Studying the effect of different concentrations of glutamic acid and Nano zinc oxide and their interactions on vegetative growth characteristics and mineral content in the lavender plant.
2. Knowing the possibility of cultivating the lavender plant under the conditionsof Salah El-Din Governorate due to its environmental and medical importance.

Noroozlo et al. (2019). Show when spraying with glycine and glutamic on lettuceat concentrations (1000,500,250,0) $mg.L^{-1}$the interaction transaction was characterized by spraying (with glycine at a concentration of $250mg.L^{-1}$+ glutamic at a concentration of $250mg.L^{-1}$) It gave the highest significant differences in the total chlorophyll content, which amounted to (32.3mg. L^{-1}) and the content of carotenoids amounted to (2.8) mg.g fresh weight and iron content (69.7) mg.kg-1 dry weight.

Mazher et al. (2011) mentioned an experiment to show the effect of spraying with glutamic acid at concentrations of (0, 100 and 200) mg. L^{-1} on Croton plant, as the spraying treatment with a concentration of 200 $mg.L^{-1}$ was significantly superior in increasing the ratio of nitrogen, phosphorous, and potassium. Ahmadreza *et al.* (2020) found when spraying basil with two Nano-zinc oxide elements at concentrations (0, 1000, 2000, and 4000) mg. $Liter^{-1}$ and Nano copper in concentrations (0, 1000, 2000, and 4000) mg. L^{-1} had a significant effect on most ofthe vegetative and chemical growth traits.

Mays and Abdul kareem (2019) were found when spraying Moringa oleifera lam plant with titanium oxide and Nano zinc oxide at a concentration of 50 mg. $liter^{-1}$ for each of them in addition to the comparison treatment, as the zinc oxide transaction gave the best results in terms of the leaves' content of calcium, iron, percentage of protein, percentage of total carbohydrates, a-carotene, Niaziridin, chlorogenic acid, gallic acid and vitamin C. which reached (2.20 , 29.62 , 21.98 , 13.47 , 34.12 , 28.69 , 30.67 , 900.25 , 29.29) respectively .

Materials and Methods

The study was conducted in the wooden canopy of the Department of Horticulture and garden Engineering / College of Agriculture / University of Tikrit During the agricultural season 2021-2022, the experiment included studying the effects of spraying with glutamic acid and Nano-zinc oxide on some characteristics of

vegetative growth, mineral content, active substances, and some anatomical characteristics of the lavender plant, Lavendula Angustifolia Mill, , Lavender seedlings were selected after they were obtained from a local nursery in Dohuk governorate on11/2/2021 in cork pots. The seedlings were transferred to plastic pots with a diameter of (22 cm) on21/2 / 2021 , planted in mixed soil and Petmos at a ratio of 2:1

Experimental design and parameters used

The study consisted of two factors: The first factor: spraying with glutamic acid (C5H9NO4), symbolized by A, and atthree levels:

G0: comparison transaction (spray with distilled water only)
G1: Spraying with glutamic acid at a concentration of 100 mg .L $^{1-}$
G2: Spraying with glutamic acid at a concentration of 200 mg .L $^{1-}$

The second factor: spraying with zinc oxide nano-ZnO NP5, symbolized by Z, and at four levels:

Z0: comparison treatment (spraying with distilled water only) Z1: spraying with nano zinc oxide at a concentration of 0.50 g.L^{-1}Z2: spraying with Nano-zinc oxide at a concentration of 1 g.L^{-1} Z3: spraying with Nano-zinc at a concentration of 1.50 g.L-^{1} The study consisted of (12) factorial transaction from the interactions of factors So, the number of plants in one experimental unit became 4 pots and in three replications, 12 x 4 x 3 = 144 seedlings were used in experience the plants were sprayed with glutamic acid in three batches, the first one a month after the transferof seedlings 2/2/2021 and the second 10 days after the first batch, and the third 10days after the second batch, ,., As for the Nano zinc oxide spray, it was sprayed five days after each spray with glutamic acid, and the experiment was designed according to the Randomized Complete Block Design (RCBD).

Studied traits

Plant height (cm. Plant^{-1}). The main stem was measured from the area of contact with the soil to the highest growing top of the plant using a tape measure for threeplants from each experimental unit, and then its average was taken.
Number of leaves (leaf. plant-^{1}). The total number of leaves of plants wascalculated by counting the number of leaves for three plants from each experimental unit and then extracting their average.
Total chlorophyll content of leaves (mg.g.$^{1-}$soft weight) The total chlorophyll content of leaves was estimated according to (Knudson et al. 1977)

Determination of nutrients in the leaves was estimated each

Nitrogen concentration(%N) using the Microkildahl apparatus and according to the method reported by Blak (1985) based on A.O.A.C., 1980).
The determination of the potassium concentration (K) was determined by aflame photometer and according to the method described by Black (1985).
Determination of zinc concentration (mg. kg^{-1}) The zinc content was measured according to (Cresser and Parsons, 1979) method.

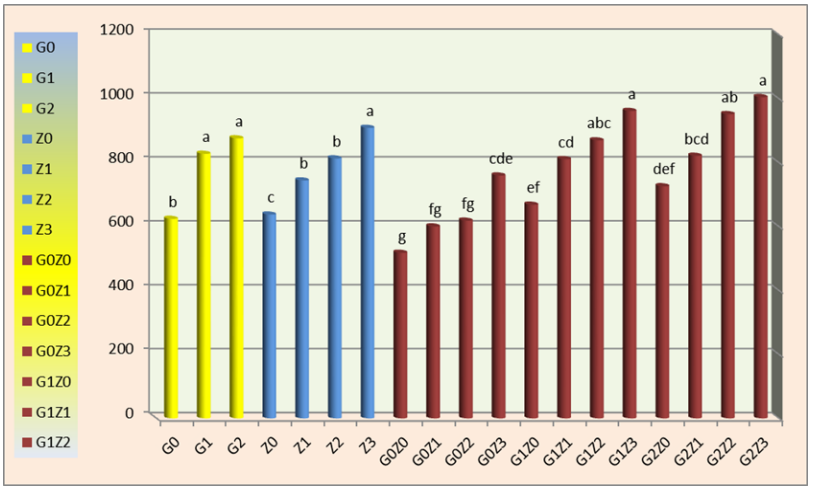
The experiment was carried out according to a Randomized Complete Block Design (RCBD). As a factorial experiment, the results were analyzed using the SAS program and the averages were compared according to Duncan's polynomial test at a probability level of 5%.

parameter	plant height
G0	22.4208
G1	29.1533
G2	32.4750
Z0	23.627
Z1	26.864
Z2	29.300
Z3	32.274
G0Z0	18.140
G0Z1	22.053
G0Z2	23.410
G0Z3	26.080
G1Z0	24.240
G1Z1	27.000
G1Z2	30.810
G1Z3	34.563
G2Z0	28.500
G2Z1	31.540
G2Z2	33.680
G2Z3	36.180
parameter	Number of leaves
G0	624.14
G1	827.74
G2	876.12
Z0	637.53
Z1	744.31
Z2	813.34
Z3	908.81
G0Z0	518.01
G0Z1	600.32
G0Z2	618.51
G0Z3	759.71
G1Z0	668.41
G1Z1	811.09
G1Z2	869.72
G1Z3	961.72
G2Z0	726.17
G2Z1	821.51
G2Z2	951.8
G2Z3	1005

Results and Discussion

Effect of spraying with glutamic acid and Nano zinc oxide on some vegetative growth characteristics of lavender plants Figure (1,2,3) shows that spraying with glutamic acid gave significant differences in the rate of plant height, number of leaves, and leaf content of total chlorophyll. The transaction G2 was characterized by spraying with glutamic acid at a concentration (200 mg.L^{-1}) by giving the highest average values for the previously mentioned traits, which reached (32.475 cm. $plant^{-1}$, 876.12 leaves. $plant^{-1}$, 35.128 mg.g^{-1}-fresh weight) respectively. Compare the lowest values in the comparison transaction. Whereas, the transaction of Z3 sprayed with a concentration of 1.50 g.L^{-1} with the highest rate for each plant height, which reached 32.274 cm. $Plant^{-1}$, the number of leaves was 908.81 leaves. $Plant^{-1}$ The total chlorophyll content of theleaves is 36.273 mg.gm-^{1} soft weight, Compared to the no-spray transaction . The interaction transaction G2Z3 (spraying with glutamic acid at a concentration of 200 mg.l-1 + Nano-zinc oxide at a concentration of 1.50 g.l-^{1}) was superior by giving the highest differences for the above-mentioned traits, which amounted to (36.180 cm.$plant^{-1}$, 1005.00 leaf.$plant^{-1}$). , 39.415 mg. g^{-1} – soft weight) respectively. Compared to the comparison transaction , which gave the lowest values

* Figure (1) shows the effect of spraying with glutamic acid and Nano zinc oxide and their interactions on the plant height characteristic of lavender plants.
* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test and at the 5% probability level



* Figure (2) shows the effect of spraying with glutamic acid and Nano zinc oxideand their interactions on the number of leaves of the lavender plant.
* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test and atthe 5% probability level.

* Figure (3) shows the effect of spraying with glutamic acid and nano zinc oxide and their interactions on the chlorophyll content of lavender leaves.
* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test and at the 5% probability level

parameter	chlorophyll content
G0	26.478
G1	33.950
G2	35.128
Z0	26.015
Z1	31.644
Z2	33.476
Z3	36.273
G0Z0	22.403
G0Z1	26.003
G0Z2	27.093
G0Z3	30.413
G1Z0	29.601
G1Z1	32.598
G1Z2	34.612
G1Z3	38.990
G2Z0	26.041
G2Z1	36.331

Effect of spraying with glutamic acid and Nano zinc oxide on the mineral content of lavender leaves

Figures (4,5,6) show that spraying with glutamic acid has a significant effect on the average percentage of nitrogen, potassium and zinc in the leaves. The transaction of G2 spraying with a concentration of (200mg.l-1) outperformed with the highest average concentration of the

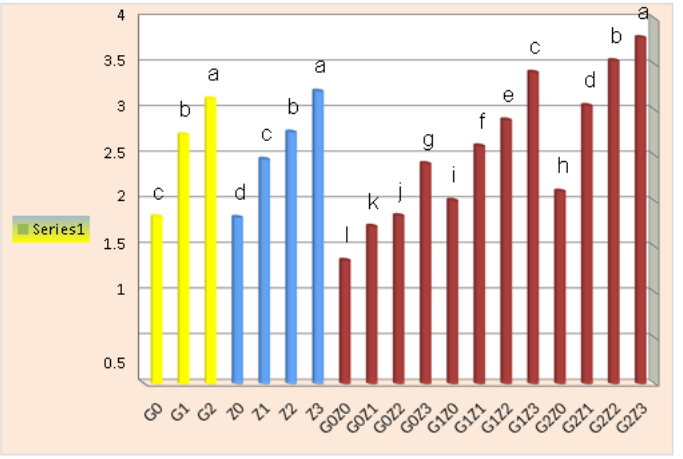
paramete
Nitrogen %

above elements in the leaves amounting to (3.122%, 2.4820%,37.030 mg.kg-1) respectively, The same figures indicate that spraying with Nano-zinc oxide has caused significant differences, as the Z3 transaction outperformed the spraying at a concentration of (1.50 g.l-1) by giving the highest concentration of the pelleted elements in the above which amounted to (3.205%,2.6186%, 38.217 mg.kg-1) respectively. As for the interaction transaction , they showed significant differences, and the transaction G2Z3 (spraying with glutamic

r G0 G1 G2 Z0 Z1 Z2 Z3 G0Z0 G0Z1 G0Z2 G0Z3 G1Z0 G1Z1 G1Z2 G1Z3 G2Z0 G2Z1 G2Z2

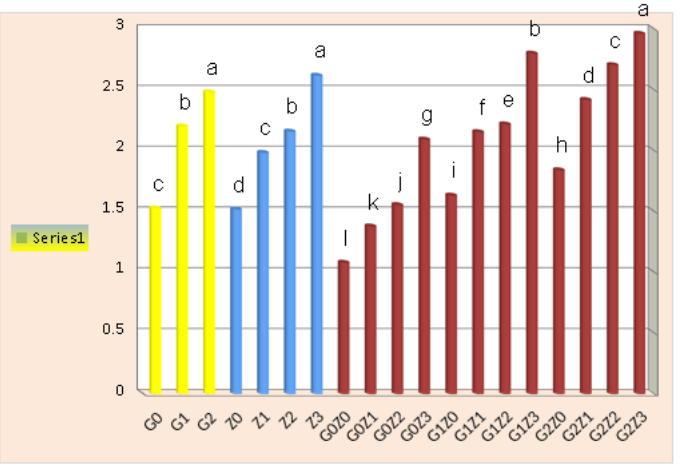
G2Z3
G2Z2 G2Z3
38.724
39.415
1.8317
2.7287
3.1225
1.8226
2.4590
2.7570
3.2053
1.3510
1.7240
1.8410
2.4110
2.0080
2.6050
2.8900
3.4120
2.1090
3.0480
3.5400
3.7930

acid at a concentration of 200 mg.l-^{1} $^{+}$ Nano zinc oxide at a concentration of 1.50 g.l-^{1}) was distinguished by giving the highest concentration of nitrogen, potassium, and zinc in the leaves, which amounted to (3.793%, 2.9630%, and 41.430 mg.kg-1)respectively, compared to the comparison transaction.



* Figure (4) shows the effect of spraying with glutamic acid and Nano-zinc oxideand their interactions on the nitrogen concentration of lavender plants.
* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test and atthe 5% probability level

parameter	Potassium %
G0	1.5262
G1	2.2010
G2	2.4820
Z0	1.5176
Z1	1.9836
Z2	2.1590
Z3	2.6186
G0Z0	1.0800
G0Z1	1.3780
G0Z2	1.5540
G0Z3	2.0930
G1Z0	1.6320
G1Z1	2.1540
G1Z2	2.2180
G1Z3	2.8000
G2Z0	1.8410
G2Z1	2.4190
G2Z2	2.7050
G2Z3	2.9630



* Figure (5) shows the effect of spraying with glutamic acid and Nano-zinc oxideand their interactions on potassium concentration of lavender plants.
* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test and atthe 5% probability level
* Figure (6) shows the effect of spraying with glutamic acid and Nano zinc oxide and their interactions on the zinc concentration oflavender plants
* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test and at the 5% probability level

parameter	zinc
G0	28.955
G1	36.065
G2	37.030
Z0	27.057
Z1	34.603
Z2	36.190
Z3	38.217
G0Z0	22.580
G0Z1	29.300
G0Z2	30.800
G0Z3	33.140
G1Z0	31.410
G1Z1	36.000
G1Z2	36.770
G1Z3	40.080
G2Z0	27.180
G2Z1	38.510
G2Z2	41.000
G2Z3	41.430

Discussion

The significant effect of the foliar spray method in increasing thevegetative growth indicators of lavender plants, is attributed to the significant superiority of the foliar spray method in the characteristics of vegetative growth represented by the height of the plant, the number of leaves and total chlorophyll shapes (3,2,1) The reason is due to the rapid arrival of nutrients added by the foliar spray method and their representation in the sites of metabolism through stomata in leaves or wounds and scratches in the layer of the cuticle and through cytoplasmic bridges to reach the cells at a faster time, which helps in the continuity of the nutritional tide and metabolic processes Ruttkay - Nedecky et al.,2017)

The increase in the characteristics of vegetable growth when treated with amino acids can also be explained by steeve (2003) that some compounds are called plantgrowth substances, In general, they are similar to hormones in their work as they control the use of nutrients for the coordinated and balanced development of the plant body, and growth regulators are used as natural compounds directly on the plant to change its life processes or structure to improve the quality and productivity of plants. Or it may be that amino acids increase DNA synthesis (Smith, 1985), stimulate various processes associated with protein synthesis (Dattaet al., 1986) and stimulate cell division (Cartines-Egea and Mizrahi, 1991).

Spraying with glutamic acid led to a significant increase in the characteristics of vegetative growth due to the presence of nitrogen in the amino acid glutamic, which is more ready for absorption, which is positively reflected in the increase in growth by increasing the number of cells in the plant in general since amino acids

contribute to increasing respiration, which leads to Production of energy compounds (ATP), which is used by the plant during growth (Guzman, 2009)

The significant effect of zinc oxide nanoparticles in increasing vegetative growth characteristics from plant height, number of leaves, and total chlorophyll, is due tothe role of zinc in the formation of the important amino acid tryptophan in the formation of IAA, which affects the increase in cell division and enhances the activity and division of meristematic cells, and increases the length of the internodes and enters into the formation of plasma membrane. It is involved in many plant cell functions and has a key role in protecting plant cells from oxidation (Sharifi, 2016). Which is reflected positively in increasing all the characteristics of vegetative growth. The increase in the percentage of nitrogen, potassium, phosphorous and zinc in theleaves when spraying amino acid may be due to the indirect role of carbohydrates as a primary source of nitrogenous materials through the formation of organic acids, especially mevanolic acid (Rao et al., 1970).

We conclude through the study

Spraying with glutamic acid at a concentration of (200 mg.L-1) increased the rate of vegetative growth characteristics and most of the mineral content traits, and spraying with nano zinc oxide at a concentration of (1.50 gm.L-1) showed the highest significant differences in the average of most vegetative growth traits and mineral content. As for the interaction transaction , transaction A2Z3 (spraying with glutamic acid at a concentration of 200 mg.l-1 + Nano zinc oxide at a concentration of 1.50 g.l-1)gave the highest significant differences in most of the vegetative growth characteristics and mineral content. Through the results, we recommend: conducting future studies using higher levels of glutamic acid and Nano zinc oxide on the same plant or on other plants.

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