East African Scholars Journal of Agriculture and Life Sciences
*Abbreviated Key Title: East African Scholars J Agri Life Sci*
ISSN 2617-4472 (Print) | ISSN 2617-7277 (Online)
Published By East African Scholars Publisher, Kenya
Volume-4 | Issue-1 | January-2021|
DOI:10.36349/easjals.2021.v04i01.003

Research Article

# The Role of Proline and Nano-Fert in Growth of Pelargonium (*Pelargonium graveolens* L.) Under Different Irrigation Period

Alaa Sabah Osman*, Asmaa Mohammed Adil
Department of Horticulture and Landscape design, Collage Agriculture and Forestry, University of Mosul, Iraq

**Article History**
**Received:** 28.12.2020
**Accepted:** 12.01.2021
**Published:** 30.01.2021

**Journal homepage:** http://www.easpublisher.com

**Quick Response Code**

**Abstract:** This study was carried out in lath house belong to Department /Horticulture and Landscape design /college of Agriculture and Forestry / University of Mosul for the period from (1 July 2019) to (1 December 2019), to determine the effect of foliar application of proline at (zero, 25, 50) mg.l$^{-1}$ as well as treatment with Optimus plus fertilizer which was produce according to nano technology consist of (5% Nitrogen, 30% Amino acid, 3% Organic nitrogen) at (zero, 1) ml.l$^{-1}$ sprayed on the vegetative growth and between sprinkle and the next 20 days, the last factor include three irrigation levels of watering at (100%, 50%, 25%) of filed capacity in growth of *pelargonium graveolens* L.. The experiment were analyzed statistically by using Factorial with in Split-Plot Design in randomized Complete Block Design with three replication and five plant per treatment, was used. Duncan test used to compare between means at 0.05 probability level. The irrigation level 25% of F.C caused significant decrease in the most of studded parameters. The difference in spraying with the amino acid proline caused a significant increase in the parameters of: number of branches, length of the longest root, proline content and volatile oil ratio. But spraying by nano fertilizer Optimus plus cause significantly increased the all growth, chemical and anatomic parameters.

**Keywords:** *pelargonium graveolens* L., anatomic parameters, nanofertilizers, Optimus plus, Ornamental plants.



## INTRODUCTION

Ornamental plants are plants that grown for the beauty of their external appearance, such as their leaves, flowers, fruits, or aromatic scent, and one of the ornamental plants is *Pelorgonium graveolens* L., which belongs to the Geraniaceae family and is now grown in most Arab and foreign countries as an ornamental plant for its beautiful appearance and distinctive aromatic scent.and this plant concedered on of the important aromatic plants, whose leaves and tender branches contain essential oils, and it is a perennial plant whose height does not exceed 50 cm , the leaves are long necks-rough to the touch, thick, light green, wrinkled, containing fluff and the whole leaf shape is almost round, and branches a lot into fine branches, intense aromatic which can be distinguished when the tissue of the leaf is torn or touched. The flowers bear in the form of small purple or pink inflorescences Khudair [1]. Stress can be defined as a deviation from the ideal state of plant life that negatively affects its functions, and water stress in particular is a situation in which the rate of water loss through transpiration or evaporation is higher than the rate of water absorption from the soil, which may cause a decrease in the water content of plant tissues than the natural level. The effect of stress at the beginning may be temporary and reversible, but it turns into a permanently with the length of the plant's exposure to stress, and the degree of influence of the different aspects of the plant's life is proportional to the intensity and duration of stress. Simple stress leads to minor effects that most plants can withstand, especially if the stress is temporary, but it may fade these effects are removed by the elimination of stress and with the increase of stress, the plant's divergence from normal conditions in terms of growth, development and productivity increases, so the rate of growth decreases and may stop with the intensification of stress. Proline protects the cell against damage or any environmental stress due to its natural properties, as it changes the nature of cell walls, making them hydrophilic, adhering to them and working to control pH, and thus helps plants resist environmental harshness Heidari [2]. Nanoparticles are defined as materials that contain at least one of its nanoscale dimensions. The term nanoscale can be defined as the volumes in the range from 1 nanometer (nm) to less than 1 micrometer (mm) [3]. Attempts to increase the efficiency of the use of conventional nitrogen fertilizers have not been effective enough, in addition to the strategies that have emerged related to nanofertilizers can have an important role in this field due to the high surface area that these compounds possess, which can be expected that these compounds will excel on conventional slow release fertilizers [4]. The aim of this study is to assessing the effect of foliar application of proline as well as tretment with Optimus plus fertilizer which was produce according to nano technology sprayed and different irrigation levels of watering on the vegetative growth of *pelargonium graveolens* L.

# MATERIAL AND METHODS

The experiment was conducted in the lath house of the Department of Horticulture and landscape design / College of Agriculture and Forestry / University of Mosul for the period from (1 July 2019) to (1 December 2019) on the aromatic geranium plant *Pelargonium graveolens* L., used two-month-old plants with uniform growth after they were punched on a date 25 may 2019 at a height of 15 cm, the plants were replanted in plastic pots with a diameter of 21 cm in lomy-sandy soil after the soil was treated with insecticide and fungicide Bentanol and Zoro super at a concentration of 1 $ml.l^{-1}$ and each pot contained 5 kg Of the lomy-sandy soil. The experiment were analyzed statistically by using Factorial with in Split-Plot Design in randomized Complete Block Design with three replication and five plant per treatment , was used. Duncan test used to compare between means at 0.05 probability level. Three factors studied in the experiment: The first factor: plants were sprayed with three concentrations of the amino acid Proline: 0, 25 and 50 $mg.l^{-1}$ every 20 days throughout the experiment period. The second factor: the use of the nano fert. Optimus plus produced according to nanotechnology, which contains (5% nitrogen, 30% amino acids and 3% organic nitrogen) in two concentrations (0, 1 $ml.l^{-1}$) according to the company's recommendation, every 20 days throughout the experiment period . The third factor: the use of three levels of irrigation, the first level is 100% of the field capacity, the second level is 50% of the field capacity, and the third level is 25% of the field capacity. The field capacity of the soil used in the study was estimated by taking a pot filled with about 6 kg of soil, which was completely air and solar dried, then soil was irrigated to the extent of full saturation and left for 48 hours, taking into the reduction of the amount of water vapor by placing a plastic cover on the pot and left until another descent a drop of gravitational water through the bottom holes of the pot and then weighed again. The calculation method was according to the method mentioned by Sutcliffe [23] as follows:

Weight of water lost = Weight of wet soil - Weight of dry soil

Percentage of water in 6 kg / soil = weight of water lost / weight of dry soil x 100

Where the field capacity = 18.6%

**Characteistic studied**

**The number of branches**: as the branches on the main stem of each plant were counted at the of the experment.

**The leaf area ($cm^2$):** was measured according to the method [5]:

leaf area = weight of copied paper x area of reproduction paper /weight of the reproduction paper

Then the number of leaves on each plant was calculated and the leaf area of the plant was obtained by multiplying the number of leaves per plant x the area of one leaf.

**The average length of the longest root(cm):** It was measured by using a tape measure inserted from the base of the vegetative part(or the stem-root connection area)to the end of the root.

**Proline content estimation:** was estimated according to the method described by Troll and Lindsley [22], as 0.2 g of dry matter (leaves) was taken and 5 ml of ethanol was added to it at a concentration of 95% then the extract was centrifuged by (Centerifuge 80 device. -2) about 3500 cycles for 30 minutes, after that the clear portion was taken and evaporated in a water bath type (Lab Tech) at a temperature of 85 degrees Celsius until complete dryness, then 5 ml of distilled water was added to the remaining part and a centrifugation process was performed at 3500 cycles for 30 minutes, then 3 ml of the clear portion was taken and read in a Spectrophptomeyer (Jenway 6750) at a wavelength of 520 nanometers.

**Estimation of the percentage of aromatic Volatile oil**: oil was extracted from the vegetative parts (leaves) of the aromatic geraniums by using the water distillation method relative to Britsh pharmacopoeia (1968), which was mentioned by Ranganna [6]. The amount of volatile oil gm/plant =Total weight of first cut x percentage of volatile oil.

**Determination somatal area ($\mu m^2$):** measurements of stomatal area were taken by using an HDMC-5 microscope camera provided with Scope image.

# RESULTS

**Number of Branches**

The data in Table-1 indicate that the irrigation level at 100% of F.C. led to a significant increase in the number of branches of a plant, as the maximum increase was 11.20 $branch.plant^{-1}$, while spraying plant with proline acid at a concentration of 25 $mg.l^{-1}$ led to a significant increase in this characteristic reached to 9.60 branch. $Plant^{-1}$ compared to spraying with a concentration of 50 $mg.l^{-1}$, which gave the lowest values 8.68 $branch.plant^{-1}$, as well as spraying plant with nano-fert. Optimus plus recorded the highest significant value 9.73 branch. $Plant^{-1}$ at a concentration of 1 ml.$l^{-1}$ compared without spray treatment, which recorded the lowest value 8.48 branch.plant$^{-1}$. The interaction between irrigation levels and spraying plant with proline recorded the highest significant value under irrigation level at 100% of F.C. with spraying plant at a concentration of 25 mg.$l^{-1}$ proline acid 11.70 branch.Plant$^{-1}$ while these values decreased to the lowest 7.20 branch.Plant$^{-1}$ under irrigation level at 25% of F.C. with spraying proline acid at a concentration of 50 mg.$l^{-1}$.While the interaction between irrigation levels and nano-fert. had a significant superiority under irrigation level at 100% of F.C. with spraying Optimus plus at a concentration of 1 ml.$l^{-1}$ it reached to 11.83 branch. Plant$^{-1}$, while this value decreased to its lowest when growing the plant under irrigation level of 50% of F.C. without spraying of nano-fert, it reached 7.30 branch.plant$^{-1}$.The interaction between proline and Optimus plus concentrations had a significant effect on this characteristic, as the largest values reaching 10.30 branch.Plant$^{-1}$ when spraying with a concentration of 25 mg.$l^{-1}$ proline and spraying with a concentration of 1 ml.$l^{-1}$ of Optimus plus, while the values decreased to the lowest. 8.13 branch. Plant$^{-1}$ when spraying at a concentration of 50 mg.$l^{-1}$ proline acid without spraying of Optimus plus. The triple interaction between the studied factors show a significant variation in their values, as the largest values were obtained, which reached to 12.66 branch. Plant$^{-1}$ at irrigation level 100% of F.C. with spraying plant at a concentration of 25 mg.$l^{-1}$ of proline acid and spraying with a concentration 1 ml.$l^{-1}$ of nano-fert. while the value decreased to 6.75 branch. Plant$^{-1}$ at irrigation level 25% of F.C. with spraying at a concentration 50 mg.$l^{-1}$ of proline and without spraying with nano-fertilizer.

**Leaf Area**

The results in Table-2 indicate that irrigation levels significantly affected the characteristic of leaf area of the plant and the largest value was 3489.9 $cm^2$ at irrigation level 100% of F.C. as compared to 1726.1 $cm^2$ under irrigation level 25% of F.C. While spraying plant with amino acid proline didn't significantly effect on the values, the largest value was recorded 2893.0 $cm^2$ at spraying with a concentration of 50 mg.$l^{-1}$ compared to 2762.0 $cm^2$ without spraying plant with proline, but when spraying plant with the nano fertilizer Optimus plus, it resulted in significant differences between the values, the largest value was 3338.0 $cm^2$ when spraying at a concentration of 1 ml.$l^{-1}$ compared to 2285.0 $cm^2$ without spraying treatment and it was clearly evident in the two-factor interaction data between the studied factors that plants growth under irrigation level at 100% and 50% of F.C. regardless of the concentration used from proline, the values did not differentiate significantly, while the lowest values were recorded 1628.38 $cm^2$ under irrigation level at 25% of F.C. without spraying with any-proline, the significant effect was found from the interaction between irrigation and spraying levels with nano--fert the largest values were recorded 4209.95 $cm^2$ under irrigation level 100% of F.C. with spraying at a concentration of 1m.$l^{-1}$ of nano-fert. , while this value decreased to 1346.08 $cm^2$ at irrigation level 25% of F.C. without spraying nano-fert., and the interference with the spraying of proline and spraying with the nano fertilizer Optimus plus resulted in a significant difference between the values, so the largest values were recorded 3412.95 $cm^2$ when spraying at a concentration of 50 mg.$l^{-1}$ of proline acid with spraying at a concentration of 1 ml.$l^{-1}$ of nano-fert. compared to 2186.77 $cm^2$ when spraying at a concentration of 25 mg.$l^{-1}$ proline acid without foliar application of Optimus plus. It is noticed from the triple interaction data between the studied factors that the largest values were recorded 4459.32 $cm^2$ obtained as a result of planting plants under irrigation level 100% of F.C. with spraying at a concentration of 50 mg.$l^{-1}$ of proline and spraying at a concentration 1 ml.$l^{-1}$of nano-fert. at a time this value decreased to 1302.28 $cm^2$ under irrigation level of 25% of F.C. with spraying at concentration of 25 mg.$l^{-1}$ proline and without spraying of nano-fertilizer.

**Root Length**

The results in Table (3) indicate that irrigation levels significantly affected the characteristic of the longest root of the plant. As the growing plants are below irrigation level 25% of F.C. the maximum increase was78.51 cm compared with the irrigation level 100% of F.C. which recorded the lowest value 51.48cm, and it is noticed from the data that spraying plants with a concentration of 25 mg.$l^{-1}$ of proline led to a significant increase in the length of the longest root of the plant, which reached to 66.81 cm, while this value decreased to 62.61 cm when spraying with distilled water only. Also, the spraying with the nano fertilizer Optimus plus individually resulted in significant differences between the values, the largest recorded value was 68.56 cm when spraying plant with a concentration of 1 ml.$l^{-1}$ compared to 61.81 cm without spraying. The bilateral interaction between irrigation levels and spraying with proline had a significant effect on this characteristic, and the largest values were 80.27 cm at a 25% irrigation level of F.C. interfered with the spray at a concentration of 50 mg.$l^{-1}$ proline acid, while the values decreased to as low as 50.88 cm at irrigation level 100% of F.C. with spraying at a concentration of 50 mg.$l^{-1}$ of proline, the same was the case when the interaction between irrigation levels and spraying with nano-fert.which is showed a significant effect, and the largest values were 81.74 cm at the irrigation level 25% of F.C. with spraying at a concentration of 1 ml.$l^{-1}$ of nano-fert. while the lowest values were recorded 48.44 cm at irrigation level 100% of F.C. without spraying of nano-fert. As for the interaction between the different concentrations of spraying between Proline and Optimus plus, significant differences were found between the values, and the direction of the results was the increase in the characteristic of the longest root length of the plant when spraying plants at a concentration of 50 mg.$l^{-1}$and spraying at a concentration of 1 $ml.l^{-1}$ of nano-fert. , it reached to 70.74 cm compared to 60.29 cm without spraying with both fators. It appears from the results of the triple interaction between the study subject factors that the largest plant root length 84.55 cm was recorded for plants growing under irrigation level at 25% of F.C. with spraying with the amino acid proline at a concentration of 50 $mg.l^{-1}$ and spraying at a concentration of 1 $ml.l^{-1}$ of nano-fert. Optimus plus and this value differed significantly with values of several triple interference coefficients which are reduced to 47.44 cm at irrigation level 100% of F.C. at spraying with proline at a concentration of 50 $mg.l^{-1}$ and without spraying nano fertilizer.

**Content of Proline**

The results of Table-4 indicate that plants grown under different irrigation levels were significantly effected and the irrigation level superior at 25% of F.C. the highest increase gave 541.34 µg.g $D.W^{-1}$ while the values decreased to the lowest at irrigation level 100% of F.C.and reached to 125.04 µg.g $D.W^{-1}$. As well as for spraying with the amino acid proline, as it caused a significant effect on the values, and the largest increase was recorded 359.68 µg.g $D.W^{-1}$ at spraying with a concentration of 50 $mg.l^{-1}$ compared with the treatment without spraying wich is record the lowest values 228.60 µg.g $D.W^{-1}$ . While the foliar application of nano fertilizer Optimus plus caused a significant effect on the values, with the largest value reaching 311.65 µg.g $D.W^{-1}$ at spraying with a concentration of 1 $ml.l^{-1}$ in contrast to the plants without spraying, which recorded 275.45 µg.g $D.W^{-1}$. As for the bilateral interaction between irrigation levels and proline amino acid spraying, a significant differences appeared between the values of the parameters, and the largest values obtained were recorded 681.52 µg.g $D.W^{-1}$ under irrigation level of 25% of F.C. interfered with spraying at a concentration of 50 $mg.l^{-1}$ of proline acid compered with 101.42 µg.g $D.W^{-1}$ under irrigation level 100% of F.C. without spraying of proline. The data of the interference between the two factors of irrigation levels and spraying with nano fertilizer showed significant effects on the values, and the largest values were recorded 581.12 µg.g $D.W^{-1}$ under irrigation level 25% of F.C. with spraying at a concentration of 1 $ml.l^{-1}$ of nano-fert.while the lowest values were recorded 119.27 µg.g $D.W^{-1}$ at irrigation level 100% of F.C. without spraying with nano-fert. The results of the interaction between the levels of spraying with the amino acid proline and the Nano fertilizer showed significant differences, as the largest increase was recorded 376.60 µg.g $D.W^{-1}$ when spraying at a concentration of 50 $mg.l^{-1}$ of proline acid and spraying at a concentration of 1 $ml.l^{-1}$ of nano-fert. compared to the no-spray treatment for both fators, which recorded the lowest values of 206.66 µg.g $D.W^{-1}$. From the triple interference data of the studied factors, the results indicated that there was a high significant effect on the values for the characteristic of content of proline as the best values were obtained when planting plants under the irrigation level 25% of F.C. with spraying proline acid at a concentration of 50 $mg.l^{-1}$ and spraying at a concentration of 1 $ml.l^{-1}$ of nano-fert. reached to 716.10 µg.g $D.W^{-1}$, while the values decreased to a minimum of 94.73 µg.g $D.W^{-1}$ in the control treatment.

**Percentage of Oil Voltial**

The data in Table-5 indicate that irrigation levels had a significant effect on the percentage of volatile oil in the plant, and the highest value reached 0.41% at the irrigation level 25% of F.C. whereas, the lowest values were recorded at irrigation level 100% of F.C. which is reached to 0.25%. And the spraying with amino acid proline led to a significant increase in this characteristic, and the maximum increase was 0.39% when spraying at a concentration of 50 $mg.l^{-1}$ this value varied. significant form the other two treatments, the data indicate that the use of a concentration of 1 $ml.l^{-1}$ of the Optimus plus led to the maximum increase in the percentage of volatile oil in the plant, reaching to 0.35% compared to the control treatment, which recorded the lowest value 0.29%. The data of the bilateral interaction between irrigation and proline spraying showed that there were significant differences between the treatments, and the maximum increase in the percentage of volatile oil in the plant occurred at an irrigation level 25% of F.C. with spraying at a concentration of 50 $mg.l^{-1}$ proline acid, as the increase reached 0.55%.compared to the irrigation level at 100% of F.C. regardless of proline acid concentrations used which is record 0.25%. The results of the interaction between irrigation levels and spraying with nano-fert. showed that, below the irrigation level 25% of F.C. with spraying at a concentration 1 $ml.l^{-1}$ of nano-fert. gave a maximum increase 0.45% while the values decreased to 0.23% at irrigation level 100% of F.C. without spraying nano-fert. and it is clear from the data on the interaction of spraying with different concentrations of the amino acid proline and the nano-fert. that with increasing the spraying with the concentration of proline to 50 $mg.l^{-1}$ and spraying with a concentration of 1 $ml.l^{-1}$ of the nano-fert.led to an increase in the percentage of the oil. the volitail oil in the plant was 0.44%, while the lowest value 0.24% appeared without spraying of both factors. As for the triple interaction between the study subject factors, the percentage of volatile oil increased significantly in plants growing under the irrigation level of 25% of F.C. and sprayed with the amino acid proline at a concentration of 50 $mg.l^{-1}$ and sprayed with nano-fert. at a concentration of 1 $ml.l^{-1}$ recorded a maximum increase 0.63%, while the lowest value 0.23% was recorded at irrigation level 100% of F.C., regardless of the concentration used of proline and without spraying nano-fert.

**Stomatal Area**

It is noted from Table-6 that irrigation levels did not significantly effect the characteristic of the stomatal area although the largest increase was recorded at irrigation level 100% of F.C. reached to 45.98 µm $^{2}$, with regard spraying with proline, didnt significantly effect the values of the parameters for the characteristic of the stomatal area of the leaf, while when spraying with nano-fert. showed a significant effect, and the largest value was recorded at 34.14 µm $^{2}$ at a concentration 1 ml.l$^{-1}$ compared to 26.03 µm$^{2}$ without spraying. As for the bilateral interference of the studied parameters, it found significant effects on the values of these parameters. the largest values were recorded 49.89 µm$^{2}$ under the irrigation level 100% of F.C. with spraying at a concentration 25 mg.l$^{-1}$ of proline acid, while the lowest values were recorded 17.03 µm$^{2}$ under irrigation level 25% of F.C. with spraying at a concentration 50 mg.l$^{-1}$ of proline acid, wheres the interaction between irrigation and spraying levels with nano-fert.record the largest values 51.84 µm$^{2}$ at irrigation level 100% of F.C. with nano-fert. spray at a concentration 1 ml.l$^{-1}$ compared to 17.62 µm$^{2}$ at a irrigation level 25% of F.C. without spraying with nano fertilizer Likewise, the highest significant values were recorded 36.60 µm$^{2}$ when the spray at a concentration of 25 mg.l$^{-1}$ of proline acid and sprayed with a concentration of 1 ml.l$^{-1}$ nano-fert. while the lowest values were recorded 24.20 µm $^{2}$ when spraying with a concentration 50 mg.l$^{-1}$ of proline acid without spraying nano-fertilizer. The results of the triple interference indicate that there is a significant effect of the studied factors of the stomatal area characteristic between the values of the parameters. the largest value was recorded 58.06 µm$^{2}$ at an irrigation level 100% of F.C. with spraying at a concentration 25 mg.l$^{-1}$ of proline acid and spraying with a concentration 1 ml.l$^{-1}$ of nano-fert treatment compered to 15.47 µm$^{2}$ at irrigation level 25% of F.C. with spraying at a concentration of 50 mg.l$^{-1}$ proline and without spraying nano-fertilizer.

**Table-1: The role of proline acid and Optimus plus nano-fert. and irrigation levels separately or interaction between the factors in the number of branches (branch. Plant$^{-1}$) of geranium (*pelargonium graveolens* L.)**

| Means factor )A( | Means interaction )B × A( | Nano fert.) C( Means interaction )C ×B × A( ) 1C2( | ) 0C1( | Proline ) B( | F.C )A( |
|---|---|---|---|---|---|
| 11.20 a | a 10.95 | 11.58 ab | 10.33 bcd | ) 0B1( | % 100 )A1( |
| | a 11.70 | 12.66 a | 10.75 bc | ) 25B2( | |
| | a 10.95 | 11.25 ab | 10.66 bc | ) 50B3( | |
| 8.13 b | bc 8.08 | 8.75 def | 7.41 fgh | ) 0B1( | % 50 )A2( |
| | b8.45 | 9.41 cde | 7.50 fgh | ) 25B2( | |
| | bc7.87 | 8.75 def | 7.00 gh | ) 50B3( | |
| 7.97 b | bc 8.08 | 8.66 d-g | 7.50 fgh | ) 0B1( | % 25 )A3( |
| | b 8.62 | 8.83 def | 8.41 e-h | ) 25B2( | |
| | c 7.20 | 7.66 fgh | 6.75 h | ) 50B3( | |
| | Means factor )B( | 11.83 a | 10.58 b | ) % 100A1( | Means interaction )C × A( |
| | | 8.97 c | 7.30 e | ) % 50A2( | |
| | | 8.38 cd | 7.55 de | ) % 25A3( | |
| | 9.04 ab | 9.66 ab | 8.42 cd | ) 0B1( | Means interaction )C × B( |
| | 9.60 a | 10.30 a | 8.88 bcd | ) 25B2( | |
| | 8.68 b | 9.22 bc | 8.13 d | ) 50B3( | |
| | | 9.73 a | 8.48 b | Means factor) C( | |

**Table-2: The role of proline acid and Optimus plus nano-fert. and irrigation levels separately or interaction between the factors in the leaf area (Cm$^{2}$) of geranium (*pelargonium graveolens* L.)**

| Means factor )A( | Means interaction )B × A( | Nano fert.) C( Means interaction )C ×B × A( ) 1C2( | ) 0C1( | Proline ) B( | F.C )A( |
|---|---|---|---|---|---|
| 3489.9 a | a 3642.92 | 4328.94 ab | 2956.90 c-f | ) 0B1( | % 100 )A1( |
| | a 3363.36 | 3841.61 a-c | 2885.12 c-f | ) 25B2( | |
| | a 3463.26 | 4459.32 a | 2467.20 d-g | ) 50B3( | |
| 3218.5 a | a 3014.79 | 3509.32 a-d | 2520.26 def | ) 0B1( | % 50 )A2( |
| | a 3067.01 | 3761.08 a-c | 2372.93 e-h | ) 25B2( | |
| | a 3573.74 | 3823.13 a-c | 3324.34 b-e | ) 50B3( | |
| 1726.1 b | b 1628.38 | 1848.44 fgh | 1408.31 gh | ) 0B1( | % 25 )A3( |
| | b 1907.91 | 2513.54 def | 1302.28 h | ) 25B2( | |
| | b 1642.02 | 1956.40 fgh | 1327.63 h | ) 50B3( | |

| | | | | | |
|---|---|---|---|---|---|
| | **Means factor )B(** | 4209.95 a | 2769.74 b | **) % 100A1(** | **Means interaction )C × A(** |
| | | 3697.84 a | 2739.18 b | **) % 50A2(** | |
| | | 2106.13 c | 1346.08 d | **) % 25A3(** | |
| | 2762.0 a | 3228.90 a | 2295.16 b | **) 0B1(** | **Means interaction )C × B(** |
| | 2779.4 a | 3372.08 a | 2186.77 b | **) 25B2(** | |
| | 2893.0 a | 3412.95 a | 2373.06 b | **) 50B3(** | |
| | | 3338.0 a | 2285.0 b | **Means factor) C(** | |

**Table-3: The role of proline acid and Optimus plus nano-fert. and irrigation levels separately or interaction between the factors in theroot length(Cm)of geranium (*pelargonium graveolens* L.)**

| **Means factor )A(** | **Means interaction )B × A(** | **Nano fert.) C( Means interaction )C ×B × A(** | | **Proline ) B(** | **F.C )A(** |
|---|---|---|---|---|---|
| | | **) 1C2(** | **) 0C1(** | | |
| 51.48 c | e 51.66 | 54.22 efg | 49.11 fg | **) 0B1(** | **% 100 )A1(** |
| | e 51.89 | 55.00 ef | 48.77 fg | **) 25B2(** | |
| | e 50.88 | 54.33 efg | 47.44 g | **) 50B3(** | |
| 65.57 b | d 60.99 | 62.77 d | 59.22 de | **) 0B1(** | **% 50 )A2(** |
| | c 68.44 | 72.22 c | 64.66 e | **) 25B2(** | |
| | c 67.27 | 73.33 c | 61.22 de | **) 50B3(** | |
| 78.51 a | b75.16 | 77.77 bc | 72.55 c | **) 0B1(** | **% 25 )A3(** |
| | a 80.11 | 82.89 ab | 77.33 bc | **) 25B2(** | |
| | a 80.27 | 84.55 a | 76.00 bc | **) 50B3(** | |
| | **Means factor )B(** | 54.52 e | 48.44 f | **) % 100A1(** | **Means interaction )C × A(** |
| | | 69.44 c | 61.70 d | **) % 50A2(** | |
| | | 81.74 a | 75.29 b | **) % 25A3(** | |
| | 62.61 b | 64.92 b | 60.29 c | **) 0B1(** | **Means interaction )C × B(** |
| | 66.81 a | 70.03 a | 63.59 bc | **) 25B2(** | |
| | 66.14 a | 70.74 a | 61.55 bc | **) 50B3(** | |
| | | 68.56 a | 61.81 b | **Means factor) C(** | |

**Table-4: The role of proline acid and Optimus plus nano-fert. and irrigation levels separately or interaction between the factors in the content of prolin (µg.g D.W$^{-1}$ ) of geranium (*pelargonium graveolens* L.).**

| **Means factor )A(** | **Means interaction )B × A(** | **Nano fert.) C( Means interaction )C ×B × A(** | | **Proline ) B(** | **F.C )A(** |
|---|---|---|---|---|---|
| | | **) 1C2(** | **) 0C1(** | | |
| 125.04 c | h101.42 | 108.12 mn | 94.73 n | **) 0B1(** | **% 100 )A1(** |
| | gh124.85 | 130.43 lmn | 119.27 mn | **) 25B2(** | |
| | fg148.83 | 153.86 j-m | 143.81 k-n | **) 50B3(** | |
| 214.29 b | ef 182.30 | 190.67 h-k | 173.94 i-l | **) 0B1(** | **% 50 )A2(** |
| | e 211.86 | 218.56 ghi | 205.17 hij | **) 25B2(** | |
| | d 248.68 | 259.83 g | 237.52 gh | **) 50B3(** | |
| 541.34 a | c402.07 | 452.83 e | 351.31 f | **) 0B1(** | **% 25 )A3(** |
| | b540.40 | 574.43 c | 506.38 d | **) 25B2(** | |
| | a 681.52 | 716.10 a | 646.94 b | **) 50B3(** | |
| | **Means factor )B(** | 130.80 d | 119.27 d | **) % 100A1(** | **Means interaction )C × A(** |
| | | 223.02 c | 205.54 c | **) % 50A2(** | |
| | | 581.12 a | 501.54 b | **) % 25A3(** | |
| | 228.60 c | 250.54 d | 206.66 e | **) 0B1(** | **Means interaction )C × B(** |
| | 292.37 b | 307.80 c | 276.94 d | **) 25B2(** | |
| | 359.68 a | 376.60 a | 342.76 b | **) 50B3(** | |
| | | 311.65 a | 275.45 b | **Means factor) C(** | |

**Table-5: The role of proline acid and Optimus plus nano-fert and irrigation levels separately or interaction between the factors percentage of volitail oil ( % ) of geranium (*pelargonium graveolens* L.)**

| Means factor )A( | Means interaction )B × A( | Nano fert.) C( Means interaction )C ×B × A( | | Proline ) B( | F.C )A( |
|---|---|---|---|---|---|
| | | ) 1C2( | ) 0C1( | | |
| 0.25 c | e 0.25 | 0.26 de | 0.23 e | ) 0B1( | % 100 )A1( |
| | e 0.25 | 0.26 de | 0.23 e | ) 25B2( | |
| | e 0.25 | 0.26 de | 0.23 e | ) 50B3( | |
| 0.31 b | e 0.25 | 0.26 de | 0.23 e | ) 0B1( | % 50 )A2( |
| | cd 0.32 | 0.33 de | 0.31 de | ) 25B2( | |
| | bc 0.38 | 0.43 bc | 0.33 de | ) 50B3( | |
| 0.41 a | de 0.26 | 0.26 de | 0.26 de | ) 0B1( | % 25 )A3( |
| | b 0.41 | 0.46 b | 0.36 cd | ) 25B2( | |
| | a 0.55 | 0.63 a | 0.46 b | ) 50B3( | |
| | Means factor )B( | 0.26 de | 0.23 e | ) % 100A1( | Means interaction )C × A( |
| | | 0.34 bc | 0.29 cd | ) % 50A2( | |
| | | 0.45 a | 0.36 b | ) % 25A3( | |
| | 0.25 c | 0.26 cd | 0.24 d | ) 0B1( | Means interaction )C × B( |
| | 0.33 b | 0.35 b | 0.30 bc | ) 25B2( | |
| | 0.39 a | 0.44 a | 0.34 b | ) 50B3( | |
| | | 0.35 a | 0.29 b | Means factor) C( | |

**Table-6: The role of proline acid and Optimus plus nano-fert. and irrigation levels separately or interation between the factors in stomatal area ($\mu m^2$) of geranium (*pelargonium graveolens* L.)**

| Means factor )A( | Means interaction )B × A( | Nano fert.) C( Means interaction )C ×B × A( | | Proline ) B( | F.C )A( |
|---|---|---|---|---|---|
| | | ) 1C2( | ) 0C1( | | |
| 45.98 a | a 45.45 | 50.21 ab | 40.69 bcd | ) 0B1( | % 100 )A1( |
| | a 49.89 | 58.06 a | 41.73 bc | ) 25B2( | |
| | a 42.58 | 47.26أب | 37.89 b-e | ) 50B3( | |
| 23.36 a | b 22.11 | 25.62 def | 18.59 f | ) 0B1( | % 50 )A2( |
| | b 24.61 | 25.98 def | 23.23 ef | ) 25B2( | |
| | b 23.36 | 27.47 c-f | 19.25 f | ) 50B3( | |
| 20.93 a | b 24.04 | 28.33 c-f | 19.76 f | ) 0B1( | % 25 )A3( |
| | b 21.70 | 25.78 def | 17.62 f | ) 25B2( | |
| | b 17.03 | 18.58 f | 15.47 f | ) 50B3( | |
| | Means factor )B( | 51.84 a | 40.10 b | ) % 100A1( | Means interaction )C × A( |
| | | 26.36 c | 20.36 cd | ) % 50A2( | |
| | | 24.23 dc | 17.62 d | ) % 25A3( | |
| | 30.53 a | 34.72 ab | 26.35 bc | ) 0B1( | Means interaction )C × B( |
| | 32.07 a | 36.60 a | 27.53 bc | ) 25B2( | |
| | 27.65 a | 31.10 abc | 24.20 c | ) 50B3( | |
| | | 34.14 a | 26.03 b | Means factor) C( | |

**Fig-1: Cross-section of the aromatic geranium leaf, *Pelargonium graveolens* L. taken from plants growing under 100% irrigation level of F.C. (40X)**

**Fig-2: Cross-section of the aromatic geranium leaf, *Pelargonium graveolens* L. taken from plants growing under 25% irrigation level of F.C. (40X)**

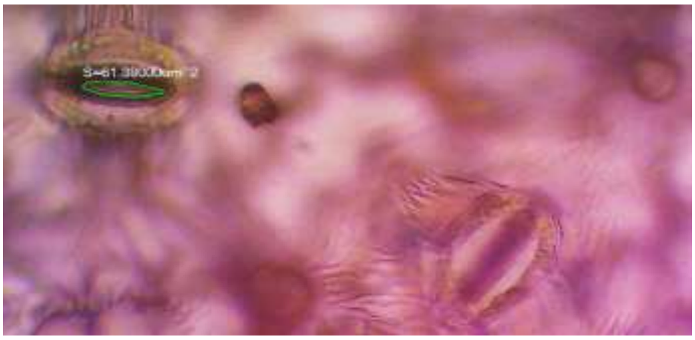

**Fig-3: Cross-section of the aromatic geranium leaf, *Pelargonium graveolens* L., taken from plants growing under 100% irrigation level of F.C. sprying at 25 mg.1$^{-1}$ proline and 1ml.l$^{-1}$ Optimus plus (40x)**

**Fig-4: Cross-section of the aromatic geranium leaf, *Pelargonium graveolens* L., taken from plants growing under 25% irrigation level of F.C. sprying at 50 mg.1$^{-1}$ proline and 1ml.l$^{-1}$ Optimus plus (40x)**

# DISCUSSION

in this study it was found that there is a high significant effect at the concentration of sprayed proline on the plant specialy at spraying with a concentration 25 mg.l-1 in the characteristic the number of branches of the plant and the reason may be due to the addition of proline to the plant activates many important hormones in vegetative growth, such as auxin and cytokinin [7] and that spraying with amino acids contributes to the increase in the number of branches as a result of their role in stimulating physiological and biochemical processes, as these acids contribute to building proteins and manufacturing carbohydrates through building chlorophyll and stimulating photosynthesis, which contributes to improving plant growth and also contributes to encouraging the action of enzymes, co-enzyme, and bases of Purine and Pyrimidine [8, 9], proline plays as a growth catalyst as the addition of amino acids, including proline, which is considered a basic source of nitrogen important in building proteins, enzymes and preparing energy that encourages vegetative and root growth Mohamed and Khalil [10] these results are similar to What Al-Saadi [11] found when studying tomatoes. The spraying plant with proline acid has caused a significant increase in the characteristic of the length of the roots, at a concentration of 25 mg.l$^{-1}$ superior on the rest of the other concentrations thats due to the role of proline as osmotic preservate and free redical scavenger and it has a second role which maintaing the membrane the cellular stability and consedered source of nitrogen Abbas [12]. Also, free amino acids when added are a basic nitrogen source in building proteins and enzymes and preparing energy that encourages radical growth by Abdel-Aziz and Balbaa [13] also the amino acids increase the duration and number of cell divisions, and their expansion Idris [14].

The spraying with nano fert had a significant effect on the values of the characteristics. as the spraying treatment with a concentration of 1 ml.$L^{-1}$ gave the highest value, and this increase may also be attributed to the nitrogen contained in one of its components and thus the amount of nitrogen present will effect the level of cytokinins within the plant, which effect in stimulating new growths from lateral shoots, thus breaking the apical dominance and increasing the number of branches [15, 16] that irrigation levels had a significant effect on the average leaf area and the largest increase was under irrigation level 100% of F.C. the reason may be due to the increase in the hydration area around the root system and the volume of the wet of soil, thus washing salts away from the root zone and increasing the effective ability of the roots to absorb the largest amount of water and nutrients, as this improves the physiological and biological activities inside the plant, which is positively reflected in the increase in the synthesis process. Photosynthesis, which increases the amount of carbohydrates that are produced by the leaves in this process, which greatly contributes to increasing the leaf area [17-19]. proline is produced in plant tissues due to its inability to build protein, in addition to the quantities resulting from protein catabolism, and it collects in the leaves more quickly than the rest of the plant parts and its quantity is proportional to the severity and severity of exposure to stress and accumulates to change in leaf osmosis because it is an amosmic regulator of Mattioli *et al*., [20], Proline is a free radical picker and saves cells from the destructive effects of them, as it generates an osmotic potential that leads to a decrease in the activity of the enzyme Super Oxidase Dismutase (SOD), which maintains the process of photosynthesis and prevents the oxidation of lipids in the cell membrane or increased degradation of protein [21].

## CONCLUSION

The following is concluded from the study:

- When spraying proline, most of the studied characteristics increased significantly, which confirms the ability of proline to improve the morphological and physiological characteristics of plants subjected to stress, as spraying vegetative growths with different concentrations of proline acid positively affected some of the characteristics of vegetative and root growth and the chemical content of the plant, especially at a concentration 50 mg.$1^{-1}$ which caused an increase in the percentage of volatile oil, the content of proline and the length of the longest root.
- The results of the current study showed that spraying plants with a concentration of 1 ml.$1^{-1}$ of the Optimus Plus nano-fert. 6 times during the expermental period led to an increase in the chemical and anatomical content characteristics in addition to a significant improvement in the vegetative and root growth characteristics of the plant.
- We conclude that drought stress had a significant effect on the decrease of most of the studied characteristics of aromatic geraniums, especially at the irrigation level 25% of F.C.
- The highest percentage of volatile oil, proline content in leaves and longest root length were obtained under irrigation level 25% of F.C.
- The results of the current study showed that the interaction between irrigation levels and proline concentration had a positive effect in improving the growth characteristics of aromatic geranium plants when the plant was subjected to water stress. Thus, spraying with proline acid improved the growth characteristics of the plant at irrigation levels and had a positive role in reducing damage water tension and this is important from the economic side in rationing the amount of water used.
- The interaction between irrigation levels and plant spraying with the Optimus plus nano-fert. at a concentration 1 $ml^{-1}$ had a positive role in reducing the water tension damage in the characteristics of the studied indicators.
- -The treatment of proline amino acid spraying and optimus plus nano-fert. spraying with different irrigation levels had a clear significant effect on chemical and anatomical characteristics as well as vegetative and root growth characteristics.

## RECOMMENDATION

From the above, we can recommend the following:

- We recommend using the amino acid proline sprinkler in fields similar to the conditions of the study and circulating it on open fields and on commercial ornamental plants and other medicinal aromatic plants because of its ability to reduce and resist water tension damage.
- We recommend that you conduct extensive studies to know the possibility of using higher concentrations of the Optimus Plus nanofertilizer (prepared with nanotechnology) in order to reduce the use of conventional fertilizers harmful to the environment and thus reduce environmental pollution.
- The use of different concentrations of the amino acid proline and the Optimus plus nano-fert. with different concentrations and spraying times.
- It is possible to reduce the damage of water tension through the use of some treatments such as spraying with proline amino acid at a concentration of 25 and 50 mg.$l^{-1}$ and spraying with nano-fert. Optimus plus at a concentration of 1 ml.$l^{-1}$.

- Avoid exposing the plant geranium to thirst because of its negative impact on the characteristics of vegetative growth.
- To obtain a high percentage of volatile oil, we recommend exposing aromatic medicinal plants to drought stress, especially irrigation level of 25% of F.C.
- Rationing the plant's water consumption during its growth period after finding the means that contribute to protecting the plant from the negative effects of water stress through foliar spraying with the amino acid proline and the Optimus plus nano-fert.
- Study other types of geranium to find out their effect and response to proline and Optimus plus nano-fert with different irrigation levels.

## REFERANCE


1. Khudair, M. (2001). Ornamental plants, Ministry of Higher Education and Scientific Research, University of Baghdad. Iraq.
2. Heidari, M. (2010). Nucleic acid metabolism proline concentration and antioxidants enzyme activity in canola (*Brassica nupus* L) under salanty stress. Aagric. Sci. China, q, 504-511.
3. Buzea, C., Pacheco, I., & Robbie, K. (2007). Nanomaterials and nanoparticles: source and toxicity. Biointerphases 2: Mr17-Mr71.
4. Hossain, K. Z., Monearl, C. M., & Sayari, A. (2008). Adsorption of urease on PE-MCM-41 and its catalyticeffect on hydrolysis of urea. Collid Surf B. 62: 42-50.
5. Patton, L. (1984). Photosynthesis and growth of willow used for short rotation forestry. Ph. D. Thesis submitted to the Univ. Of Dublin (Trinty college).
6. Ranganna, S. (1985). Handbook of Analysis and Quality control for fruit and vegetable products Second edition, TATA Megraw Hill publishing Company limted Delhi.
7. Pinheiro, C., Antonio, Orton, M. F., Dobrev, P. J., Hartung, W. T., Thomas-Oates, J., Ricardo, C. P., Vankova, R. Chaves, M., Wilson, J. C. (2011). Initial water defeciat effection Lupines albus L. Photosynthesis performance, carbon metabolism and hormonal balance metabolic reorganization prior to early stress responses. *Journal of Experimental Botany*. 62(14), 4965-4074.
8. Al-Said, M. A., & Kamal, A. M. (2008). Effect of foliar spray with folic acid and some amino acids on flowering yield and quality of sweet pepper. *J Agric Sci Mansoura Univ*, 33 (10): 7403-7412.
9. Khalil, A. A., Osman, E. A. M., & Zahran, F. A. F. (2009). Effect of amino acids and micronutrients foliar application on growth, yield and its componens and chemical characteristics. *J Agric Sci Mansoura Univ*, 33(40): 3143-3150.
10. Mohamed, S. M., & Khalil, M. M. (1992). Effect of tryptophan and arginine on growth and flowering of some winter annuals. *Egypt J Applied Sci*, 7(10): 82-93.
11. Al-Saadi, M. M. K. (2001). The response of tomato plants to salinity of irrigation water and proline. Master Thesis, College of Agriculture, Basra University, Iraq.
12. Abbas, M. F., Jasim, A. M., & AL-Zubaidy, B. H. (2012). The effect of proline on groeth and iconic composition of embryogenic callus and somatic embryos of the date palm (Phoenix actylifera L. Cv. Ashkar) under NaCl stress. *Inter J of Farming and Allied Sci*, 1(30: 82-87.
13. Nahed, G. A., & Balbaa, L. K. (2007). Influence of tyrosine and zinc on growth, flowering and chemical constituents of Salvia farinacea plants. *J Applied Sci Res*, 3(11): 1479-1489.
14. Idris, M. H. (2009). Plant physiology. Encyclopedia of plants. Suzan Mubarak Scientific Exploration Center in Cairo, Egypt.
15. Leopold, A. C. (1975). Aging, senescence, and turnover in plants. *BioScience*, *25*(10), 659-662.
16. Isa, S. S., Almaraz, R., & Magovern, J. (1984). Leiomyosarcoma of the penis. Case report and review of the literature. *Cancer*, *54*(5), 939-942.
17. Wilhite, B., Mushett, C. A., Goldenberg, L., & Trader, B. R. (1997). Promoting inclusive sport and leisure participation: Evaluation of the Paralympic Day in the schools model. *Adapted Physical Activity Quarterly*, *14*(2), 131-146.
18. Al-Saati, A. (2003). The permissible gharar (risk) in classical Islamic jurisprudence. *Journal of King Abdulaziz University: Islamic Economics*, *16*(2).
19. Sarhan, A. A., & Bolm, C. (2009). Iron (III) chloride in oxidative C–C coupling reactions. *Chemical Society Reviews*, *38*(9), 2730-2744.
20. Mattioli, R., Costantino, P., & Trovato, M. (2009). Proline accumulation in plants: not only stress. *Plant signaling & behavior*, *4*(11), 1016-1018.
21. Tan, E. K., Tan, L. C., Lim, H. Q., Li, R., Tang, M., Yih, Y., ... & Zhao, Y. (2008). LRRK2 R1628P increases risk of Parkinson's disease: replication evidence. *Human genetics*, *124*(3), 287-288.
22. Troll, W., & Lindsly. J. (1955). Aphotometric method for determination of proline. *J Biol Chem*. 216: 655-661.
23. Sutcliffe, J. (1979). Plants and Water. Studies in Biology no. 142nd ed .Pp.122


**Cite this article:** Alaa Sabah Osman *et al* (2021). The Role of Proline and Nano-Fert in Growth of Pelargonium (*Pelargonium graveolens* L.) Under Different Irrigation Period. *East African Scholars J Agri Life Sci, 4*(1), 15-24.