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# The effect of spraying alpha-tociferol and the amino acid Phenylalanine on the vegetative and floral growth of *Mirabilis Jalapa* L.

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## Abstract

The experiment was conducted in the fabric shade of the Department of Horticulture and Landscape Engineering - College of Agriculture - University of Basra, Karma Ali site, during the agricultural season 2023-2024. The seeds were planted on 10/15/2023 directly in two plastic anvils with a capacity of 5 kg per kilo, with three seeds in each anvil. After germination and the appearance of true leaves, the plants were thinned and only one plant remained. The experiment included studying the effect of two factors: spraying the amino acid Phenylalanine at four concentrations: comparison (spraying with distilled water) and spraying with the amino acid Phenylalanine at a concentration of 50 mg. L-1, 100 mg. L-1, and 150 mg. L-1, and spraying with Alpha-Tocopherol at four concentrations: comparison (spraying with distilled water), 50 mg. L-1, and 100 mg. L-1 and 150 mg L-1. The study showed that the plants sprayed with alpha-tocopherol and the amino acid Phenylalanine at a concentration of 150 mg L-1 were significantly superior to the other two concentrations in most of the studied traits, such as plant height (cm), number of leaves (leaf/plant-1), leaf area (cm2), number of branches (branch/plant-1), number of flowers (flower/plant-1), leaf content of total soluble carbohydrates (mg/100 gm-1 fresh weight), leaf content of mineral elements, percentage of nitrogen (%), percentage of potassium (%), percentage of phosphorus (%).

## I. Introduction

Medicinal plants have played a vital role worldwide in the treatment, prevention and control of a variety of diseases. The primary benefits of using plant-derived medicines are that they are relatively safer than synthetic alternatives. According to the World Health Organization (WHO), about 65-80% of the world's population in developing countries rely primarily on plants for primary health care due to poverty and lack of access to modern medicine (Irena et al., 2007).

The plant Laleh Abbas. L Mirabilis Jalapa, whose English name is Marvel Of Peru, belongs to the Nyctaginaceae family and is also called the four o'clock plant because its flowers usually bloom after four o'clock in the summer. It is also known as the nightshade, native to the southern United States, Mexico and Peru. It is a plant that can withstand high temperatures and drought. It is watered moderately throughout the year. Due to the beauty of its flowers, which contain multiple colors, it is grown as an ornamental plant and is also grown for medicinal purposes (Kumar et al, 2017). The plant is characterized by producing many spherical, wrinkled, black seeds that fall from the plant after they ripen to grow into new plants. (Al-Akkam, 2021).

The extracts of the aerial parts or roots of this plant are rich in many biologically active compounds such as terpenes, proteins, flavonoids, alkaloids, and steroids as well as Alanine, alpha-amyrins, arabinose, beta-amyrins, campesterol, daucosterol, and dopamine ( Nowshin et al., 2008 and Deepak et al., 2010 ). Studies have shown that the medicinal plant during its growth stages needs some nutritional supplements and mineral and organic fertilizers to increase the vegetative mass, which in turn increases the amount of active substances produced by the plant ( Al-Shahat, 2000 ). Amino acids are considered biostimulants that encourage plant growth under unfavorable conditions ( Dabrowski et al., 2008 ).

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Amino acids are considered the most important and influential factors in plant growth and development, especially the vegetative group, as their addition affects the improvement and increase of vegetative growth, as spraying the plant with foliar nutrients increases their readiness and entry into the construction and formation of organic compounds that work to increase and improve plant growth (Taize and Zeiger, 2006). Phenylalanine is one of the amino acids that are vital compounds that play a role as basic units in the biosynthesis of protein in all biological systems when linked to each other. The chemical structure of this acid consists of a group of terminal carbon atoms, an acidic carboxyl group, and a basic amine group. (Al-Akayshi, 2020). Recent research and reviews have indicated that Phenylalanine participates as an initiator in the production and formation of cinnamic acid, which forms various flavonoids, tannins and lignans (Al-Asadi, 2018). Phenylenediamine reduces the harmful effects of salinity on plants and increases the concentration of proteins, sugars and proline (- Samad, 2010; Jiao et al, 2018 Abd El).

The results reached by (Sliva, (2013 and EL-Sherbeny in a study on the beet plant Beta vulgaris L. when treated with the amino acid Tyrosine at concentrations of 0, 100, 200, 400 mg. L-1, significantly exceeded the concentration of 100 mg. L-1 in plant height, total number of leaves, fresh and dry weights of the vegetative group, and the content of total chlorophyll pigments in the leaves. Tocopherols belong to the lipophilic antioxidants, which are divided into four forms: alpha α, beta β, gamma ϒ, and delta δ (Rocheford et al., 2002). Alpha-tocopherol (vitamin E) is a soluble fat found in membranes rich in unsaturated fatty acids (Shao et al., 2008) It was found in all parts of the plant, but its greatest presence was in the membranes of chloroplasts. Vitamin E is the first line of defense against lipid oxidation due to its effectiveness in capturing free radicals, as it gives stability to the structure of membranes through its interaction with the acetyl groups of polyunsaturated fats. Vitamin E can also remove free radicals (ROS) such as singlet oxygen, superoxide and hydroxyl radicals with its high effectiveness (Gupta, 2011). When treating the jasmine plant Jasminum grandiflorum L. with alpha-tocopherol at concentrations of (50-100) mg. L-1, it led to an increase in the amount of oil produced from the flowers, as well as an increase in the number of flowers formed on the plant and their size, and also an increase in the fresh and dry weights of the flowers with an increase in soluble sugars and carbohydrates (Eid et al, 2010).

The experiment was carried out in the fabric shade of the Department of Horticulture and Landscape Engineering - College of Agriculture - University of Basra, Karma Ali site during the agricultural season 2023-2024, as the seeds were planted on 10/15/2023 directly in two plastic anvils with a capacity of 5 kg/kg, with three seeds in each anvil. After germination and the appearance of true leaves, the plants were thinned and only one plant remained. The experiment included studying the effect of two factors: spraying the amino acid Phenylalanine at four concentrations: comparison (spraying with distilled water) and spraying with the amino acid Phenylalanine at a concentration of 50 mg. L-1, 100 mg. L-1, and 150 mg. L-1, and spraying with Alpha-Tocopherol at four concentrations: comparison (spraying with distilled water), 50 mg. L-1, and 100 mg. 1 L-1 and 150 mg. L-1 After preparing the solutions at the above mentioned concentrations for each of the amino acid Phenylalanine and Alpha-Tocopherol, and adding a few drops of the spreader Tween-20, the spraying process was carried out on the leaves using a 5-liter hand sprayer until completely wet. The process was repeated 3 times during the growing season with a time interval of 15 days between spraying and another.

## II. Results and discussion

**1- Effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on plant height (cm)**

It is clear from Table (1) that the two study factors, spraying with the amino acid Phenylalanine and alpha-tocopherol and the interaction between them, had a significant effect on the plant height trait, as the plants sprayed with phenylalanine at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest plant height of 80.25 leaves compared to the lowest plant height resulting from the comparison treatment, which amounted to 62.42 leaves, which differed significantly from the other two concentrations.

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The same table shows that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase, as the highest plant height was recorded at 78.42 cm compared to the comparison treatment, which gave 69.00. As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the highest height, reaching 90.00 cm, compared to the lowest height resulting from the comparison treatment, which amounted to 58.00 cm.

Table No. (1) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on plant height (cm).

**2--The effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the number of branches (plant branch$^{-1}$)**

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 62.42 | 67.67 | 64.00 | 60.00 | 58.00 | 0 |
| 72.83 | 77.00 | 74.33 | 71.67 | 68.33 | 50 |
| 75.33 | 78.00 | 75.00 | 67.00 | 81.33 | 100 |
| 80.25 | 91.00 | 84.67 | 79.00 | 66.33 | 150 |
| | 78.42 | 74.50 | 68.92 | 69.00 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference 3.886 | | tocopherol 1.943 | | Phenylalanine 1.943 | |

It is clear from Table (2) that the two study factors, spraying with the amino acid phenylenediamine and alpha-tocopherol and the interaction between them, had a significant effect on the number of branches, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 were significantly superior, as they recorded the largest number of branches, reaching 21.17 branches, compared to the smallest number of branches resulting from the comparison treatment, which reached 14.08 branches, which differed significantly from the other two concentrations.

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Table No. (2) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the number of branches (branch/plant$^{-1}$)

The same table shows that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase. The largest number of branches was recorded, reaching 22.00 branches, compared to the comparison treatment, which gave 13.92 branches. As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylene at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the largest number of branches, reaching 29.00 branches, compared to the lowest number of branches resulting from the comparison treatment, which amounted to 10.33.

**3- The effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the number of leaves (plant leaf$^{-1}$)**

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 14.08 | 19.33 | 14.33 | 12.33 | 10.33 | 0 |
| 18.83 | 25.00 | 21.00 | 16.00 | 13.33 | 50 |
| 19.67 | 14.67 | 21.33 | 23.67 | 19.00 | 100 |
| 21.17 | 29.00 | 23.33 | 19.33 | 13.00 | 150 |
| | 22.00 | 20.00 | 17.83 | 13.92 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | الفنيل النين | |
| 1.460 | | 0.730 | | 0.730 | |

It is clear from Table (3) that the two factors of the study, spraying with the amino acids phenyl-nin and alpha-tocopherol, and the interaction between them, had a significant effect on the number of leaves. Plants sprayed with phenyl-nin at a concentration of 150 mg l-1 excelled significantly, as the largest number of leaves was recorded at 54.02 leaves, compared to the lowest number of leaves resulting from the comparison treatment, which amounted to 42.34 leaves, which differed. Significantly higher than the other two concentrations, it appears from the same table that spraying with alpha-

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| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 42.34 | 46.16 | 40.24 | 45.33 | 37.65 | 0 |
| 52.31 | 55.03 | 50.60 | 55.25 | 48.36 | 50 |
| 53.07 | 47.58 | 59.46 | 54.26 | 50.97 | 100 |
| 54.02 | 65.93 | 56.68 | 50.88 | 42.58 | 150 |
| | 53.67 | 51.75 | 51.43 | 44.89 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | tocopherol | | Phenylalanine | |
| 2.727 | | 1.364 | | 1.364 | |

tocopherol at a concentration of 150 mg L-1 caused a significant increase, as the largest number of leaves was recorded, reaching 53.67 leaves, compared to the comparison treatment, which gave 44.89 leaves.

As for the interaction between the two study factors, it had a significant effect when the plants sprayed with phenylnin at a concentration of 150 mg L-1 and alpha-tocopherol at a concentration of 150 mg were given. L-1 had the largest number of papers, reaching 65.93 papers, compared to the smallest number of papers resulting from the comparison transaction, which reached 37.65 papers.

Table No. (3) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the number of leaves (leaf/plant-1)

**4-The effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on leaf area (cm2)**

It is clear from Table (4) that the two study factors, spraying with the amino acid phenylenediamine and alpha-tocopherol, and the interaction between them, had a significant effect on the leaf area trait, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 were significantly superior, as they recorded the largest leaf area of 72.76 cm2 compared to the smallest leaf area resulting from the comparison treatment, which amounted to 50.79 cm2, which differed significantly from the other two concentrations. The same table shows that spraying with alpha-

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tocopherol at a concentration of 150 mg L-1 caused a significant increase, as it recorded the largest leaf area of 66.60 cm2 compared to the comparison treatment, which gave 56.38. As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the largest leaf area, which amounted to 78.14 cm2, compared to the smallest area resulting from the comparison treatment, which amounted to 45.06 cm2.

Table No. (4) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on leaf area (cm2).

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 50.79 | 58.80 | 51.75 | 47.54 | 45.06 | 0 |
| 56.13 | 66.35 | 54.33 | 48.41 | 55.42 | 50 |
| 60.26 | 63.10 | 63.06 | 58.34 | 56.54 | 100 |
| 72.76 | 78.14 | 74.59 | 69.78 | 68.52 | 150 |
| | 66.60 | 60.93 | 56.02 | 56.38 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | Phenylalanine | |
| 5.097 | | 2.549 | | 2.549 | |

The effect of Phenylalanine on plant height and its increase is due to amino acids, which are the basic building blocks for protein, which affect the structure of cell protoplasm and the formation of plant tissues, thus leading to an increase in plant height (Ziaei et al., 2012). The significant effect of the amino acid Phenylalanine on increasing the number of branches and leaf area is due to the fact that this acid increases plant growth during the vegetative stage, as well as plays the role of the basic substance in protein metabolism, and also stimulates several additional vital functions in regulating biological metabolism, such as transporting and storing nitrogen, which is considered the main element in increasing the capacity of leaf area and increasing its content of chlorophyll pigments in the leaf. This acid can be an important source of carbon, energy, and metabolism of other organic compounds.

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Such as proteins, bufurans, amines, vitamins, alkaloids, terpenoids, enzymes, etc. (Reham et al, 2016). As for the effect of Phenylalanine in increasing the number of leaves, it is due to the fact that the amino acid contains in its chemical structure the amino group NH2, which positively affects the nitrogen content of the plant (Sabouri et al, 2014). Amino acids, including Phenylalanine, play a role in stimulating cell growth by providing them with nitrogen, carbon, and energy to perform vital activities, which in turn is reflected in increasing the number of leaves in the plant (Aziz et al, 2010). The increase in plant height may be attributed to the role of alpha-tocopherol in increasing cell division and the effectiveness of a number of enzymes B-amylase, Glucosidase, etc., or perhaps its assistance in building other enzymes such as protase, Lipase (Simirnoff and Wheeler, 2000). The reason for the increase in the number of leaves and leaf area when spraying with alpha-tocopherol is due to its role in increasing the enzymatic activity responsible for the photosynthesis process, which had a positive effect on increasing these characteristics (Muhammad and Al-Younis, 1991), and this result is consistent with (Ali, 2020) in their study on the Senna plant.

**5- Effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the number of flowers (flower/plant-1)**

It is clear from Table (5) that the two study factors, spraying with the amino acid phenylene and alpha-tocopherol and the interaction between them, had a significant effect on the number of flowers, as the plants sprayed with phenylene at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest number of flowers, reaching 29.58 flowers, compared to the lowest number of flowers resulting from the comparison treatment, which reached 23.25 flowers, which differed significantly from the other two concentrations. The same table shows that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase, as it recorded the highest number of flowers, reaching 30.33 flowers, compared to the comparison treatment, which gave 21.75 flowers. As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the largest number of flowers, reaching 39.00 flowers, compared to the lowest number of flowers resulting from the comparison treatment, which reached 20.67 flowers.

Table No. (5) shows the effect of spraying with alpha-tocopherol and the

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amino acid Phenylalanine on the number of flowers (flower/plant-1)

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 23.25 | 25.67 | 24.33 | 22.33 | 20.67 | 0 |
| 28.50 | 35.33 | 30.33 | 28.33 | 24.00 | 50 |
| 28.33 | 21.33 | 31.67 | 37.00 | 23.33 | 100 |
| 29.58 | 39.00 | 31.33 | 25.00 | 19.00 | 150 |
| | 30.33 | 29.42 | 28.17 | 21.75 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | Phenylalanine | |
| 1.935 | | 0.968 | | 0.968 | |

**6- Effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on seed number**

It is clear from Table (6) that the two study factors, spraying with the amino acid phenylene and alpha-tocopherol and the interaction between them, had a significant effect on the number of seeds, as the plants sprayed with phenylene at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest number of seeds, reaching 27.58 seeds, compared to the lowest number of seeds resulting from the comparison treatment, which reached 21.25 seeds, which differed significantly from the other two concentrations. The same table shows that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase, as it recorded the highest number of seeds, reaching 28.75 seeds, compared to the comparison treatment, which gave 19.92 seeds.

As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the largest number of seeds, reaching 37.67 seeds, compared to the lowest number of seeds resulting from the comparison treatment, which reached 18.67 seeds.

Table No. (6) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the number of seeds.

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| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 21.25 | 23.67 | 22.33 | 20.33 | 18.67 | 0 |
| 27.00 | 33.33 | 28.33 | 26.67 | 22.00 | 50 |
| 26.92 | 20.33 | 30.00 | 35.67 | 21.67 | 100 |
| 27.58 | 37.67 | 30.00 | 23.00 | 17.33 | 150 |
| | 28.75 | 27.67 | 26.42 | 19.92 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | Phenylalanine | |
| 1.905 | | 0.953 | | 0.953 | |

**7- The effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of carbohydrates (mg/100g-1 dry weight)** It is clear from Table (7) that the two study factors, spraying with the amino acid phenylenediamine and alpha-tocopherol and the interaction between them, had a significant effect on the carbohydrate percentage trait, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest percentage of 4.541 (mg g-1) compared to the lowest percentage resulting from the comparison treatment, which amounted to 2.296 (mg g-1), which differed significantly from the other two concentrations.

Table No. (7) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of carbohydrates (mg/100g-1 dry weight)

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The same table shows that spraying with alpha-tocopherol at a concentration

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 2.296 | 3.918 | 2.857 | 1.318 | 1.091 | 0 |
| 3.192 | 4.440 | 3.000 | 2.921 | 2.408 | 50 |
| 3.250 | 3.917 | 3.632 | 2.807 | 2.643 | 100 |
| 4.541 | 6.032 | 2.884 | 4.374 | 4.876 | 150 |
| | 4.577 | 3.093 | 2.855 | 2.755 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | Phenylalanine | |
| 0.5409 | | 0.2705 | | 0.2705 | |

of 150 mg L-1 caused a significant increase, as it recorded the highest percentage of 4.577 (mg g-1) compared to the comparison treatment, which gave 2.755. The reason may be due to the use of amino acids, including Phenylalanine, at specific concentrations that improve the vegetative growth characteristics of the plant, thus leading to increased production and accumulation of photosynthetic materials and activating internal hormones that lead to an increase in the number of flowers (Khattab et al., 2016). These results are consistent with what was found by (Sewedan and Osman, 2014) for the Dawoodi plant Dendrathema grandiflorum L. The reason for the increase in the number of seeds may be due to the possibility of the amino acid Phenylalanine uniting with some proteins to form a complex called Protein – Fluorophenylalanine, which stimulates seed production and increases their weight (Saget, 2021). The reason for the increase in the number of flowers when plants are sprayed with alpha-tocopherol may be due to its role in stimulating vegetative growth, represented by an increase in the number of leaves and an increase in manufactured carbohydrates and their transfer to the vegetative buds and their transformation into flower buds (Naseem, 2009).

As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the highest percentage of carbohydrates, which amounted to 6.032 (mg g-1), compared to the lowest percentage resulting from the comparison treatment, which amounted to 1.091 (mg g-1).

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**8- Effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of nitrogen (%)**

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 2.163 | 3.428 | 2.040 | 1.965 | 1.218 | 0 |
| 2.793 | 3.031 | 3.170 | 2.424 | 2.548 | 50 |
| 2.412 | 2.641 | 2.438 | 2.185 | 2.384 | 100 |
| 3.368 | 4.098 | 3.608 | 2.931 | 2.836 | 150 |
| | 3.300 | 2.814 | 2.376 | 2.247 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | tocopherol | | Phenylalanine | |
| 0.0957 | | 0.0479 | | 0.0479 | |

It is clear from Table (8) that the two study factors, spraying with the amino acid phenylenediamine and alpha-tocopherol and the interaction between them, had a significant effect on the nitrogen percentage trait, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest nitrogen percentage of 3.368 compared to the lowest nitrogen percentage resulting from the comparison treatment, which amounted to 2.163, which differed significantly from the other two concentrations.

Table No. (8) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of nitrogen (%).

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The same table shows that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase, as it recorded the highest percentage of nitrogen, which amounted to 3.300 compared to the comparison treatment, which gave 2.247. As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylene at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the highest number of seeds, which

amounted to 4.098 compared to the lowest percentage of nitrogen resulting from the comparison treatment, which amounted to 1.218

**9- Effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of phosphorus (%)**

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 0.2924 | 0.3497 | 0.2593 | 0.3467 | 0.2140 | 0 |
| 0.3502 | 0.4347 | 0.3957 | 0.3727 | 0.1977 | 50 |
| 0.4992 | 0.6253 | 0.5903 | 0.5220 | 0.2593 | 100 |
| 0.7070 | 0.9053 | 0.7327 | 0.6510 | 0.5390 | 150 |
| | 0.5787 | 0.4945 | 0.4731 | 0.3025 | Average effect of alpha tocophero |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | Phenylalanine | |
| 0.05264 | | 0.02632 | | 0.02632 | |

It is clear from Table (9) that the two study factors, spraying with the amino acid phenylenediamine and alpha-tocopherol and the interaction between them, had a significant effect on the phosphorus content of the leaves, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest percentage of 0.7070 compared to the lowest percentage resulting from the comparison treatment, which reached 0.2924, which differed significantly from the other two concentrations. It is clear from the same table that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase, as it recorded the highest percentage of 0.5787 compared to the comparison treatment, which gave 0.3025. As for the interaction

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between the two study factors, it had a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the highest percentage of the phosphorus element, which reached 0.9053, compared to the lowest percentage resulting from the comparison treatment, which reached 0.2140.

Table No. (9) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of phosphorus (%).

**10 - The effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of potassium (%)**

| Average effect of phenylalanine (mg/L-1) | Alpha-tocopherol (mg/L-1) | | | | Phenylalanine (mg L-1) |
|---|---|---|---|---|---|
| | 150 | 100 | 50 | 0 | |
| 0.821 | 1.583 | 0.563 | 0.833 | 0.303 | 0 |
| 1.278 | 1.463 | 1.233 | 1.290 | 1.123 | 50 |
| 1.351 | 1.443 | 1.340 | 1.307 | 1.313 | 100 |
| 2.105 | 2.620 | 2.273 | 1.627 | 1.900 | 150 |
| | 1.778 | 1.353 | 1.264 | 1.160 | Average effect of alpha tocopherol |
| L.S.D 0.05 | | | | | |
| Interference | | Tocopherol | | Phenylalanine | |
| 0.2114 | | 0.1057 | | 0.1057 | |

It is clear from Table (10) that the two study factors, spraying with the amino acid phenylenediamine and alpha-tocopherol and the interaction between them, had a significant effect on the potassium content of the leaves, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 were significantly superior, as they recorded the highest percentage of 2.105 compared to the lowest percentage resulting from the comparison treatment, which amounted to 0.821, which differed significantly from the other two concentrations. It is clear from the same table that spraying with alpha-tocopherol at a concentration of 150 mg L-1 caused a significant increase, as it recorded the highest percentage of 1.778 compared to the comparison treatment, which gave 1.160

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As for the interaction between the two study factors, it gave a significant effect, as the plants sprayed with phenylenediamine at a concentration of 150 mg L-1 and with alpha-tocopherol at a concentration of 150 mg L-1 gave the highest percentage of potassium, which amounted to 2.620, compared to the lowest percentage resulting from the comparison treatment, which amounted to 0.303.

Table No. (10) shows the effect of spraying with alpha-tocopherol and the amino acid Phenylalanine on the percentage of potassium (%).

The reason for the increase in carbohydrates when spraying with phenylalanine may be due to the relationship between the potassium content of the plant and the carbohydrate content of the leaves, as it activates the work of enzymes and increases the number of leaves, thus leading to increased growth rates, which is positively reflected in increasing the carbohydrate content of the leaves. This is consistent with Eid et al., 2010) on jasmine plants, as well as with (Sadak and Dawood, 2013) on flax plants. The reason for the effect of the amino acid phenylalanine may be attributed to the fact that it improves plant growth during the vegetative stage, as it plays the role of the basic substance in protein metabolism and stimulates several additional vital functions in regulating biological metabolism, such as transporting and storing nitrogen, which is the basic and necessary element in increasing the capacity of the leaf area, and thus its content of chlorophyll pigments in the leaf increases (Reham et al., 2016). This is consistent with what was found by (Samani et al., 2019) on sage (Salvia officinalis L.). Phenylalanine is considered a source of nitrogen and has a significant effect on the nitrogen content of leaves. Thus, nitrogen is a vital element for plant development and growth among all the required compounds. It also has an effective role in most of the plant's metabolic processes (Fathi, 2022).

, and it is also an essential nutrient for the plant, even if it plays a role in crop growth ((Bika et al, 2018 The reason for the increase in the percentage of phosphorus when spraying the amino acid Phenylalanine may be attributed to changing the osmotic potential of the osmotic tissue of the plant tissue, as it reduces the water potential, which increases the ability of cells to absorb water and nutrients, and thus this has a positive effect on increasing vegetative growth and thus exacerbating the absorption of nutrients such as phosphorus (Azza and Youssef, 2015) and this result is consistent with (Al-Fatlawi 2020) on the rice plant. The reason for the increase in the percentage of nitrogen in the leaves when spraying the plant with vitamin E may be attributed to improving the characteristics of vegetative growth by increasing the number of leaves as well as the leaf area, which leads to an increase in the plant's absorption of nutrients and their accumulation in the leaves (Talaat, 1995). Or perhaps due to the large leaf area of the plant, it leads to an increase in the activity of the plant's vital activities, including the absorption of nutrients in the soil, especially nitrogen, and thus its concentration increases ( Al-Adi, 2013). Or the increase in the percentage of nitrogen is due to increased cell division and expansion or as a result of the major elements absorbed by the plant (Chen and Chen, 2004), (Dowdle et al 2007).

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