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Effect of Biological and Chemical Fertilization on Growth of Root System and Secondary Metabolites of the plant *Pelargoniumgraveolens* L.

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ABSTRACT

A factor experiment was carried out in the horticultural facility unit of the Department of Horticulture and Gardening Engineering / College of Agriculture - Tikrit University for the period from February-June 2020 to study the effect of fertilization with Mycorrhizae and NPK on the growth of the root system and the active compounds of volatile oil in the leaves of the plant aromatic tea Pelargonium graveolens L. The experiment included two factor factors. The first is to add the biological fertilizer to the Mycorrhiza fungus at two levels without addition (comparison) and the addition at a concentration of 18 gm.pot^{-1} The second factor is spraying with chemical fertilizer NPK in three levels, the first without adding (comparison), the second is spraying the plant with 1 gm. Liter^{-1} and the third is spraying a plant with 2 gm . liter^{-1}. Implemented according to the Randomized Complete Block Design (R.C.B.D). The results showed that the treatment exceeded the addition of Mycorrhizae as the percentage of dry matter to the root total, which amounted to 26.342%. While the NPK addiction treatment exceeded the leaf content of the active compounds in the volatile oil, including Linalool, Limonene, Geraniol, and α-Pinene, it gave 4.175%, 1.168%, 29.640% and 1.625%, respectively. The interaction treatment between biological and chemical fertilization gave a significant superiority in the dry matter percentage of the root group and the leaf content of Linalool, Limonene, Geraniol and α-Pinene.

Keywords :Secondary Metabolites, *Pelargonium graveolens, Chemical Fertilization.*

Introduction

Pelargonium graveolens L., a perennial herbaceous plant, belonging to the Jaronic family, is of high economic value. It originated in southern Africa and is widely cultivated in India, China and Egypt. It is characterized by strong growth and is evergreen, its light purple flowers in the form of cluster inflorescences, simple and divided leaves uneven in size, with aromatic aroma similar to the

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smell of roses, and the active part of the aromatic tea plant is concentrated in the shoot system (Shawl et al., 2006: Singh et al .: 2011: Al-Mawsili and Al-Gamil, 2019)

As the Mycorrhizae fungus is known as a living organism that is used as a biological fertilizer that contributes to improving the growth of plants and increasing the yield, through the coexistence of most fungi with the roots of many vascular plants under natural conditions through their symbiotic relationship with plants that is not satisfactory. Among the benefits of the Mycorrhizae fungus is the fact that it acts as a mechanical barrier against diseases, and this helps to secure and protect plants from many pathological infections. It also works on the secretion of compounds with a sticky texture called Glomalin that are used as an adhesive to bind and collect soil particles and form Aggregat, in addition to the mushroom haevers to expand the surface area and absorb water and nutrients , And increases the plant's ability to withstand drought, salinity and water stress (Bashir, 2003: Khalifa et al., 2016).

For plant growth and development, the basic nutrients nitrogen, phosphorous and potassium (NPK) must be added, as these elements perform important vital functions to complete the plant life cycle. The nitrogen component is included in many organic compounds such as energy compounds, the formation of cell membranes, mitochondria and green plastids. It is also included in the synthesis of proteins, chlorophyll and many enzymatic conjugates. Phosphorous has a role in the biological processes that take place inside plant cells. While potassium activates plant enzymes and participates in many vital activities (Al-Kartani, 1988: Bidwell, 1979: Al-Naimi, 1999: Tisdale et al., 1993).

The study aimed to study the effectiveness of biological and chemical fertilizers on the behavior of root growth and the active compounds in the volatile oil of the leaves of the aromatic tea plant.

Materials and research methods

The experiment was carried out in the Horticultural Facilities Unit of the Department of Horticulture and Gardening Engineering / College of Agriculture - Tikrit University for the period from February - June 2020. The aromatic tea seedlings obtained from the green nursery in Salah al-Din Governorate were selected on February 23, 2020. Two months and a length ranging from 7-8 cm, the seedlings were transferred to large pots with a diameter of 24 cm and a height of 26 cm. They were filled with an agricultural medium consisting of 2: 1 mixed soil: peat moss.

The experiment included two factors, the first factor, adding the Mycorrhizae fungus at two levels without adding (comparison), and adding it with a concentration of 18 gm .pot^{-1} once on 4/14/2020. The second factor is spraying NPK in three levels without adding (comparison) and spraying 1 gm . liter^{-1} and 2 gm . liter^{-1} was sprayed until complete wetness and for two times, the first on 4/14/2020 and the second one month after the first spray.

The experiment was carried out according to a randomized complete block design (R.C.B.D) with three replications. Each experimental unit consisted of three pots. The following characteristics were taken on June 7 (percentage of dry matter of the root system, leaf content of Linalool,

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Limonene, Geraniol, and α-Pinene). The results were statistically analyzed and the averages were compared according to the Duncan polynomial test at 5% probability level.

Results and discussion

Table (1) The effect of biological and chemical fertilization and the interaction between them on the percentage of dry matter of the root total%

Mycorhiza gm .pot^{-1}	NPK mg . L^{-1}			Effect Mycorhiza
	0	1	2	
0	23.666 ab	24.060 ab	21.285 b	23.004 b
18	28.080 a	26.569 ab	24.376 ab	26.342 a
Effect NPK	25.873 a	25.315 ab	22.830 b	

It is noticed from Table (1) that there are significant differences in the percentage of dry matter to the root total when the plant was treated with biological fertilization, the Mycorrhizae fungus, as it gave 26.342% compared to the comparison treatment that gave the lowest percentage of 23.004%. Whereas, the results indicated that not treating the plant by spraying the chemical fertilizer NPK outperformed and gave 25.873% compared to the lowest percentage that gave 22.830%.

The same table also shows the presence of significant differences in the bilateral interaction at the level of Mycorrhizae of 18 gm . pot^{-1} and the non-treatment NPK, which gave the highest percentage of 28.080% compared to the lowest percentage, which amounted to 21.285%.

Table (2) The effect of organic and chemical fertilization and the interaction between them on the content of leaves of Linalool (mg. Gm^{-1})

Mycorhiza gm . pot^{-1}	NPK mg . L^{-1}			Effect Mycorhiza
	0	1	2	
0	3.323 f	3.601 e	3.911 c	3.612 b
18	3.678 d	4.211 b	4.438 a	4.109 a
Effect NPK	3.500 c	3.906 b	4.175 a	

It is noticed from Table (2) that there are significant differences in the leaf content of Linalool when the plant was treated with biological fertilization, the Mycorrhizae fungus, as it gave 4.109% compared to the comparison treatment, which gave the lowest amounting to 3.612%. In the results, the results indicated that the treatment of plants by spraying the chemical fertilizers NPK exceeded

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the treatment of 2 gm. liters^{-1} than the rest of the treatments as it gave 4.175% compared to the comparison treatment which gave 3.500%.

The same table also shows the presence of significant differences in the bilateral interaction at the level of Mycorrhizae fungus 18 gm . pot^{-1} and the NPK treatment 2 gm. liters^{-1}, as it gave 4.438% compared to the comparison treatment that gave 3.323%.

Table (3) The effect of biological and chemical fertilization and the interaction between them on the leaf content of Limonene (mg. Gm^{-1})

Mycorhiza gm . pot^{-1}	NPK mg . L^{-1}			Effect Mycorhiza
	0	1	2	
0	0.456 f	0.741 e	0.951 c	0.716 b
18	0.773 d	1.160 b	1.385 a	1.106 a
Effect NPK	0.615 c	0.950 b	1.168 a	

It is noticed from Table (3) that there are significant differences in the leaf content of Limonene when the plant was treated with biological fertilization, the Mycorrhizae fungus, as it gave 1.106% compared to the comparison treatment, which gave the lowest amount of 0.716%. In the results, the results indicated that the treatment of plants by spraying the chemical fertilizers NPK exceeded the treatment of 2 gm . liters^{-1} than the rest of the treatments, as it gave 1.168% compared to the comparison treatment that gave 0.615%.

The same table also shows the presence of significant differences in the bilateral interaction at the level of Mycorrhizae fungus 18 gm . pot^{-1}and the NPK treatment 2 gm . liters^{-1} as it gave 1.385% compared to the comparison treatment that gave 0.456%.

Table (4) The effect of biological and chemical fertilization and the interaction between them on the content of Geraniol leaves (mg. Gm^{-1})

Mycorhiza gm . pot^{-1}	NPK mg . L^{-1}			Effect Mycorhiza
	0	1	2	
0	28.506 f	28.875 e	29.361 c	28.914 b
18	28.910 d	29.681 b	29.920 a	29.503 a
Effect NPK	28.708 c	29.278 b	29.640 a	

It is noticed from Table (4) that there are significant differences in the leaf content of Geraniol when treating plants with biological fertilization, the Mycorrhizae fungus, as it gave 29.503% compared to the comparison treatment, which gave the lowest amount of 28.914%. In the results, the results

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indicated that the treatment of plants by spraying with chemical fertilization NPK exceeded the treatment of 2 gm . liters^{-1} for the rest of the treatments, as it gave 29.640% compared to the comparison treatment which gave 28.708%.

The same table also shows that there were significant differences in the bilateral interaction at the level of Mycorrhizae fungus 18 gm . pot^{-1} and the NPK treatment 2 gm . liters^{-1} as it gave 29.920% compared to the comparison treatment which gave 28.506%.

Table (5) The effect of biological and chemical fertilization and the interaction between them on the content of α-Pinene leaves (mg. Gm -1)

Mycorhiza gm . pot^{-1}	NPK mg . L^{-1}			Effect Mycorhiza
	0	1	2	
0	1.033 e	1.258 d	1.455 c	1.248 b
18	1.263 d	1.681 b	1.796 a	1.580 a
Effect NPK	1.148 c	1.470 b	1.625 a	

It is noticed from Table (5) that there are significant differences in the content of α-Pinene leaves when treating plants with biological fertilization, the Mycorrhizae fungus, as it gave 1.580% compared to the comparison treatment, which gave the lowest amount of 1.248%. In the results, the results indicated that the treatment of plants by spraying with chemical fertilization NPK exceeded the treatment of 2 gm .liter^{-1} than the rest of the treatments, as it gave 1.625% compared to the comparison treatment that gave 1.148%.

The same table also shows the presence of significant differences in the bilateral interaction at the level of Mycorrhizae fungus 18 gm .pot^{-1} and NPK treatment 2 gm. Liters^{-1}, as it gave 1.796% compared to the comparison treatment that gave 1.033%.

Discuss results

The significant effect of increasing the growth of the root system and the superiority of all active compounds (Linalool, Limonene, Geraniol, α-Pinene) when treated with the fungus is due to the role of the microscope in increasing the readiness and absorption of nutrients by means of a conditioner with a higher efficiency than that of the root filaments, in addition to increasing The area of absorption and these are all reflected positively on the metabolism processes inside the plant, thus improving the growth of the root system and increasing the synthesis of active substances (Al-Shaibani, 2005: Khader, 2007).

The results also showed the superiority of NPK fertilization in all volatile oil compounds (Linalool, Limonene, Geraniol, α-Pinene). This superiority is due to the provision of major elements through the addition of NPK fertilization, as the nitrogen component has an important role in increasing the secondary compounds within the plant by increasing the number of Leaves and

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vegetative growth, and increasing carbonate industrialization (Al-Asadi, 2011). As for the benefits of the element phosphorus and its role, it performs a necessary task in the processes of oxidation and reduction, through its entry into the synthesis of amino and nuclear acids, phospholipids, and enzymatic conjugations, in addition to its control over the biological reactions of the two processes of respiration and photosynthesis (Muhammad, 1985: Al-Naimi, 1999) The element potassium also has an important function in the methylation of both carbohydrates, proteins, and amino acids, and its effect on the readiness and movement of elements within plants (Muhammad and Yunus, 1991: Najm et al., 1997).

As for the interaction of these factors, the Mycorrhizae fungus and NPK gave superiority in the characteristics (Linalool, Limonene, Geraniol, α-Pinene) due to the role of these factors in common in providing the appropriate environment for the growth of the plant and providing it with its needs of nutrients and other requirements.

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