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# A Study of the Response of *Matthiola incana* L. to Organic Fertilizer "Vermicompost" and Mineral Fertilizers "Ipersol"

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**Abstract**: The experiment was conducted in the plastic greenhouse of the Department of Horticulture and Landscape at the College of Agriculture and Forestry, University of Mosul to study the effect of organic and chemical fertilization on the growth and flowering of *Matthiola Incana* L. Shabui plants. The study Included two factors: the first factor has five levels including fertilizing with a percentage of %10 and 15% organic solid fertilizer (Vermicompost) and fertilization with 0.5 and 1 ml/L of organic liquid fertilizer (Vermicompost). The second factor includes fertilization with chemical fertilizer (Ipersol) with three concentrations 0,1,2gm/pot. The experiment was carried out using a randomized complete block design with three replications and seven plants for each replicator. The results indicated that the plants fertilized with Vermicompost were distinguished by 10% and 15% in the potting medium and significantly in plant height, as well as early flowering and an increase in inflorescence length compared to the comparison treatment and fertilization with liquid Vermicompost. Fertilization with chemical fertilizers at a concentration of 2 g/pot resulted in a significant increase in plant height and chlorophyll intensity in leaves, and early flowering by about 7-8 days. The wet weight of the inflorescence increased compared to the comparison treatment as a whole. It can be said that the fertilization of the inflorescence plants with Vermicompost by 15% of the planting medium with the addition of chemical fertilizer at a concentration of 2 g / pot led to early flowering and the largest significant values were recorded for the wet weight of the inflorescence, while the largest significant values were recorded for the length of the first inflorescence when adding Vermicompost by 10% of the planting medium with the addition of chemical fertilizer at a concentration of 2 g / pot.

**Key words**: *Matthiola Incana*, Vermicompost, Ipersol, organic and chemical fertilization.

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## INTRODUCTION

The Matthiolaincana L. is one of the winter annual plants. The genus Matthiola includes approximately 50 species of annual, biennial and perennial herbaceous plants. The plant belongs to the Brassicaceae family (formerly Cruciferae) and is native to the Mediterranean basin, the Canary Islands and Western Europe **(Dole and Wilkins, 2005; Dirmenci *et al.*, 2006; Abdel-Aziz *et al.*, 2011).**

The leaves of the plant are elliptical or lanceolate, alternate slightly pubescent, silvery-green in color. The stem is straight and often woody at the base. Plant height ranges from 90 cm for cut-flower varieties and 15-25 cm for flowerbeds **(Dole and Wilkins, 2005)**. The flowers are in panicles in a Racemose inflorescence with an aromatic scent of various colors, including white, scarlet, purple, blue, red, pale yellow and pink. They are stellate with four petals. The flower is single or layered (double). flowers or as cut flowers (**Sultan *et al.*, 1992; Dole and Wilkins, 2005; Al-Tahafi *et al.*, 2013)**.

Organic fertilizers are used in clean agriculture to reduce pollution as well as improve the physical and chemical properties of the soil and raise the soil content of organic matter, which is reflected in plant growth. Vermicompost is a fertilizer rich in nutrients. It is characterized by its porosity, aeration, good water drainage, water storage and adsorption capacity, as well as its ability to retain nutrients **(Arancon and Edwards, 2005)**.

Chemical fertilizers play an essential role in improving vegetative growth and flower yield in flowering annual plants as in other plants, and they are known to respond well to the addition of chemical fertilizers, and that the appropriate supply of nutrients is the main factor that affects not only plant growth but also the yield and its type, and the effect Individually, any of these nutrients cannot give a comprehensive result of its own because their effect is mutual, and is affected by the doses of other nutrients and therefore they must be studied overlapping, especially the essential ones, although some of them are needed by the plant in small quantities **(Pimple *et al.*, 2006)**.

Aim of the study: Due to the importance of the plant in terms of coordination and the lack of research on *Matthiola incana* L. in the city of Mosul, this study was conducted with the aim of demonstrating the effect of the organic fertilizer Vermicompost and the chemical fertilizer Ipersol and finding a combination of them that improves the characteristics of the vegetative and flowering growth of the plant.

## MATERIALS AND METHODS

The experiment was conducted in the greenhouse structure of the Department of Horticulture and Landscaping at the College of Agriculture and Forestry, University of Mosul, for the period from October 2019 to May 2020 on the annual plant *Matthiola incana* L. The study included the effect of fertilizing with organic fertilizer Vermicompost solid (demok plus) and liquid (orpex) of Turkish origin. Vermicompost liquid fertilizer at concentrations of 0.5 ml / liter and 1 ml / liter of irrigation at 100 ml / pot after transferring the seedlings to pots for three times and for a period of one month between one dose and another, as well as fertilizing with the chemical fertilizer Ipersol (Dutch of Van Iperen) at concentrations of 0, 1 and 2 g/pot, 100 ml/pot, in two batches, the first one month after seeding the plants, and the second one month after the first batch.

The experiment included 18 factorial treatments, which is the interaction between the factors above. The factorial experiment was carried out using a randomized complete block design, for five levels of Vermicompost fertilizer and three levels of chemical fertilizer with three replications and seven plants per experimental unit.

The experiment was carried out when preparing the soil, and the stakes were filled with a soil mixture consisting of Vermicompost organic fertilizer (demok plus) at a volumetric ratio (v:v) of 0, 10%, and 15% with garden soil, in addition to the comparison treatment with garden soil only, where the pillars were filled with soil mixture and seedlings were planted. In the middle of the plastic pots and then watered, the liquid fertilizer Vermicopost (orpex) was added at two concentrations of 0.5 and 1 ml / liter in three batches at a rate of 100 ml / pot. Chemical fertilizer was also added at concentrations of 0, 1 and 2 g / pot in two batches, where 100 ml / pot was added.

To protect plants from diseases after planting, the fungicide finish was used at a rate of 100 ml/pot at a rate of 1 g/1 liter of irrigation to the soil, and the insecticide balance was used at a concentration of 1.25 ml/liter as a spray on the shoots. The surface soil of the pots was hoeed and weeds were removed throughout the experiment, and the plants were watered when the soil was dry and whenever needed.

Data were recorded when plants flowered and included:

Plant height (cm): measured from the soil surface to the top of the inflorescence using a tape measure and the intensity of chlorophyll (SPAD), which was measured using a spad meter, and three readings were recorded for each plant, and the average of the three readings was calculated. Flowering time (day): the trait was calculated from the date of planting the length of the inflorescence (cm) was measured from the top of the inflorescence to the end of the base of the inflorescence using a tape measure and the wet weight of the inflorescence and the inflorescence holder (gm). Using the (SAS) program, the averages were compared according to the Dunkin's multiple test under the probability level of 5% **(Al-Rawi and Khalafallah, 2000)**.

## RESULTS AND DISCUSSION

Plant height (cm): The data in Table (1) indicate that fertilizing with solid Vermicompost at a rate of 10% and 15% led to a significant increase in plant height, and the highest values were 45.382 and 44.929 cm, respectively. The plant height increased with the concentration of the chemical fertilizer, and the values differed significantly between them, reaching a maximum of 45.380 cm when fertilizing with a concentration of 2 g/pot of the chemical fertilizer. The interaction between the two types of organic fertilization, solid and liquid, and chemical fertilizer resulted in recording the highest values for plant height when fertilizing with 15% solid Vermicompost mixed with chemical fertilizer at a concentration of 2 g/pot, and reached 51.833 cm. While the lowest values when using liquid organic fertilizer with its concentration and without fertilization with chemical fertilizers were 20.333 and 22.667 cm, respectively, and in the comparison treatment of 23.750 cm.

**Table (1). Effect of Vermicompost and Ipersol on Plant Height (cm) of *Matthiola incana* L.**

| Effect compost organic Vermicompost | chemical fertilizer concentrations Ipersol gm/pot | | | Fertilizer levels Vermicompost |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| 34.128 b | 45,328 a-c | 33.305 d | 23.750 AH | **0** |
| 45.382 a | 50.467 a | 47.375 a | 38.305 d | **Vermicompost 10%** |
| 44,929 a | 51,833 a | 45,746 ab | 37.208 d | **Vermicompost 15%** |
| 32.397 b | 40.190 b-Dr | 36.667 d | 20.333 e | **Liquid Vermicompost 0.5ml/l** |
| 32.526 b | 39.083 EGP Dr | 35.828 d | 22.667 e | **Liquid Vermicompost 1 ml/L** |
| | 45.380 a | 39.784 b | 28.453 c | **The effect of chemical fertilizer Ipersol** |

Values with similar letters for each factor or their overlaps individually are not significantly different according to Duncan's multiple range test under the 5% probability level.

Chlorophyll intensity (SPAD): It is noted from the data of Table (2) that the addition of solid or liquid Vermicompost fertilizer led to recording the largest values of chlorophyll intensity in the leaves, which amounted to 69.267 and 67.963 when fertilizing with solid Vermicompost at a rate of 10% of the planting medium or liquid Vermicompost at a concentration of 1 ml / L, respectively, while the intensity of chlorophyll decreased when fertilizing with liquid Vermicompost at a concentration of 0.5 ml/L. The intensity of chlorophyll in plant leaves increased with increasing concentrations of the added chemical fertilizer, and the highest values were 81.966 when chemical fertilizer was added at a concentration of 2 g/pot, compared to 39.374 in the control treatment.

**Table (2). Effect of Vermicompost and Ipersol on Chlorophyll Intensity (SPAD) in the leaves of *Matthiola incana* L.**

| Effect compost organic Vermicompost | chemical fertilizer concentrations Ipersol gm/pot | | | Fertilizer levels Vermicompost |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| 56,803 ab | 75.33 Op | 64.17 a-Dr | 30.91 e And the | **0** |
| 69.267 a | 84.29 a | 67.73 a-c | 55.78 BD | **Vermicompost 10%** |
| 64,180 Op | 83.65 a | 65.68 a-Dr | 43.21 c-And the | **Vermicompost 15%** |
| 51,817 b | 77.42 Op | 52.61 b-e | 25.42 y | **Liquid Vermicompost 0.5ml/l** |
| 67.963 a | 89.14 a | 73.21 Op | 41.54 d-And the | **Liquid Vermicompost 1ml/l** |
| | 81.966 a | 64.679 b | 39.372 c | **The effect of chemical fertilizer Ipersol** |

Values with similar letters for each factor or their overlaps individually are not significantly different according to Duncan's multiple range test under the 5% probability level.

It is noted from the results of the bilateral interaction between organic fertilization and chemical fertilization, an increase in chlorophyll intensity in the leaves of plants fertilized with liquid Vermicompost at a concentration of 1 ml / liter mixed with chemical fertilizer at a concentration of 2 g/ pot, as it reached 89.14, in addition to an increase in the intensity of chlorophyll in the leaves when fertilizing with solid Vermicompost by 10. 15% overlap with the high concentration of chemical fertilizer, while the lowest values were when fertilizing with liquid Vermicompost at a concentration of 0.5 ml/L without the addition of chemical fertilizer, as well as in the control treatment.

Flowering time (day): The results of the statistical analysis in Table (3) showed that the plants that were fertilized with Vermicompost organic fertilizer at a rate of 10% or 15% had earlier flowering, as the plants flowered after 168,444 and 167,359 days, respectively, and differed significantly from the plants that were fertilized with liquid Vermicompost and in comparison treatment. Chemical fertilization with both concentrations 1 and 2 gm/pot significantly reduced the number of days to flowering and the values reached 171.427, 170.038 days, while it reached 178.589 days in the control treatment.

The binary interaction between the factors studied in the experiment indicated that the plants that were fertilized with 15% Vermicompost and fertilized with a chemical fertilizer of 2 g/pot had the earliest flowering, as the lowest number of days for flowering was recorded at 164,450 days, while the plants that did not fertilize or the plants that fertilized with Vermicompost with a concentration of 0.5 or 1 ml/L without the addition of chemical fertilizers at the time of flowering, as it flowered after 186.666, 179.667, and 187.250 days, respectively.

Length of the first inflorescence (cm): It is noted from the data in Table (4) that fertilizing with Vermicompost at a rate of 10% or 15% of the planting medium led to an increase in the length of the inflorescence, as the length of the inflorescence reached 14.277 and 14.159 cm, respectively, and differed significantly from Comparison treatment and treatment with two concentrations of liquid Vermicompost. Chemical fertilization with a concentration of 2 g/pot increased the inflorescence length and reached 13.239 cm. This value did not differ significantly from the inflorescence length when treated with chemical fertilizer at a concentration of 1 g/pot, but it differed significantly from the control treatment, which amounted to 7.747 cm.

**Table (3). Effect of Vermicompost and Ipersol on the flowering date (day) of *Matthiola incana* L.**

| Effect compost organic Vermicompost | chemical fertilizer concentrations Ipersol gm/pot | | | Fertilizer levels Vermicompost |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| 176.722 a | 169.555 b-Dr | 173.944 b-Dr | 186,666 a | **0** |
| 168.444 b | 169.750 b-Dr | 166.222 EGP Dr | 169.361 c d | **Vermicompost 10%** |
| 167.359 b | 164.450 d | 167.627 EGP Dr | 170,000 b-Dr | **Vermicompost 15%** |
| 176.476 a | 173.295 b-Dr | 176.467 b c | 179,667 ab | **Liquid Vermicompost 0.5ml/l** |
| 177.755 a | 173.139 b-Dr | 172.878 b-Dr | 187,250 a | **Liquid Vermicompost 1ml/l** |
| | 170,038 b | 171.427 b | 178,589 a | **The effect of chemical fertilizer Ipersol** |

Values with similar letters for each factor or their overlaps individually are not significantly different according to Duncan's multiple range test under the 5% probability level.

**Table (4). Effect of Vermicompost and Ipersol on the length of the first flower (cm) of *Matthiola incana* L.**

| Effect compost organic Vermicompost | chemical fertilizer concentrations Ipersol gm/pot | | | Fertilizer levels Vermicompost |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| 8.076 b | 11.033 c-e | 8.139 e and | 5,055 y | **0** |
| 14.277 a | 17,000 a | 15.236 a-c | 10.596 d e | **Vermicompost 10%** |
| 14.159 a | 15,892 Op | 14.003 a-d | 12.583 a-e | **Vermicompost 15%** |
| 9.175 b | 11.657 b-e | 10.367 d e | 5,500 f | **Liquid Vermicompost 0.5ml/l** |
| 8.602 b | 10.611 d e | 10.194 d e | 5,000 and | **Liquid Vermicompost 1ml/l** |
| | 13.239 a | 11,588 a | 7.747 b | **The effect of chemical fertilizer Ipersol** |

Values with similar letters for each factor or their overlaps individually are not significantly different according to Duncan's multiple range test under the 5% probability level.

The interaction values between organic fertilizers and chemical fertilizers varied in inflorescence length, and reached a maximum of 17,000 cm when fertilizing plants with Vermicompost at a rate of 10% with the addition of chemical fertilizer at a concentration of 2 g/pot, while the lowest values for inflorescence length were in the control treatment and when fertilizing with liquid fertilizer and with two concentrations. 0.5 and 1 ml/L without the addition of chemical fertilizers with values of 5.005, 5.500, and 5.000 cm, respectively. Wet weight of inflorescences and inflorescences (g): It is clear from the results of the data in Table (5) that fertilization with Vermicompost by 15% led to a significant increase in the wet weight of inflorescences and inflorescences and reached 6.106 g. It did not differ significantly from the treatment with Vermicompost by 10%. In the wet weight of inflorescences and inflorescences with increasing concentrations of chemical fertilizers, the highest values were 5.804 gm when fertilizing with Ibersol at a concentration of 2 gm/pot, while it reached 2.545 gm in the comparison treatment.

**Table (5). Effect of Vermicompost and Ipersol on Inflorescence wet weight and Inflorescence holder (g) of *Matthiola incana* L**

| Effect compost organic Vermicompost | chemical fertilizer concentrations Ipersol gm/pot | | | Fertilizer levels Vermicompost |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| 3.852 b c | 6.120 Op | 4,630 a-c | 0.805 d e | **0** |
| 5.377 Op | 6,610 Op | 5,890 Op | 3.632 b-e | **Vermicompost 10%** |
| 6.106 a | 7.813 a | 4.083 b-e | 6,420 Op | **Vermicompost 15%** |
| 2.244 c | 3.863 b-e | 2.267 c-e | 0.603 e | **Liquid Vermicompost 0.5ml/l** |
| 3.342 c | 4.615 a-c | 4.147 b-d | 1.263 c-e | **Liquid Vermicompost 1ml/l** |
| | 5.804 a | 4.203 b | 2.545 EGP | **The effect of chemical fertilizer Ipersol** |

Values with similar letters for each factor or their overlaps individually are not significantly different according to Duncan's multiple range test under the 5% probability level.

Interaction data between the studied factors recorded an increase in the wet weight of the inflorescence and the inflorescence, and the highest values were 7.813 g when fertilizing with 15% Vermicompost , adding chemical fertilizer at a concentration of 2 g / pot, while the lowest values were for the wet weight of the inflorescence and the inflorescence when fertilizing with liquid fertilizer at a concentration of 0.5 ml / liter without the addition of chemical fertilizers and in the control treatment, whose values were 0.603 g and 0.805 g, respectively.

The data in Table (1) indicate a significant increase in plant height when fertilizing with Vermicompost fertilizer by 10% and 15% of the planting medium. This result agrees with **Ghasempoor *et al.* (2013)** on the *Matthiola incana* plant and **Kumar *et al.* (2019)** on the Daoudi plant. The result is that Vermicompost increases the availability of nutrients in the soil **(Khatun *et al.*, 2018)**, where **Atiyeh *et al.* (2000)** indicated that Vermicompost has great potential to significantly improve the growth of marigold plants when used as a soil component or as a potting medium.

And that most of the nitrogen that is liberated when adding Vermicompost fertilizer is in the form of nitrate, which is the form that is ready for absorption by the plant, in addition to the content of Vermicompost fertilizer of exchange phosphorus, soluble potassium, calcium and magnesium **(Edwards and Burrows, 1988 and Orozco *et al.*, 1996)**. **Adhikary (2012)** explained that worm compost contains a high percentage of humus, which in turn improves soil porosity and thus improves aeration and increases the water storage capacity in the soil.

In addition, the humic acid present in the humus provides binding sites for many plant nutrients in exchange for calcium, iron, potassium, and phosphorus, and these nutrients are stored in humic acid in a ready form and released when the plant needs it. **Krishnamoorthy and Vajrabhaiah (1986)** showed that earthworm activity can significantly stimulate the production of cytokines and auxins in organic waste. And that the auxins and cytokinins that result from the interaction between earthworms and microorganisms may remain in the soil for a period of up to 10 weeks, but they are quickly destroyed

when exposed to sunlight and plant hormones that are absorbed by the humates remain in the soil and are released slowly from the humates and have an effect on plant growth to a large extent **(Canellas *et al.*, 2000)**.

The results of Table (2) show an increase in chlorophyll intensity in the leaves of plants fertilized with Vermicompost by 10% of the potting medium. And plants fertilized with liquid Vermicompost at a concentration of 1 ml / liter, and this agreed with **Atiyeh *et al.* (2000)** in increasing the content of chlorophyll in the leaves of the marigold plant when Vermicompost was added by 10% and 20% of potting medium **Sardoei *et al.* (2014)** on the marigold plant.

Table (3) showed that the plants fertilized with Vermicompost at a rate of 10% and 15% added to the potting medium led to an earlier flowering of the plants by about 8 and 9 days, respectively, than the treatment without the addition of Vermicompost, and this agreed with **Raha (2015)** who emphasized that The addition of Vermicompost at a rate of 40% to the culture medium led to an early flowering of the Dawoodi plants, Kasturba Gandhi. It is clear from the data in Table (4) that the addition of Vermicompost fertilizer, in proportions of 10% and 15% of the potting medium, led to an improvement in the characteristics of flowering growth.

It increased significantly the length of the inflorescence and this result agrees with **Arancon *et al.* (2004)** that Vermicompost stimulates and increases the number of flowers of **Ghasempoor *et al.* (2013)** which indicated that the addition of Vermicompost had a positive effect in increasing the number of florets in the inflorescence of a plant Al-Shboui, and the increase in flowering characteristics in the plant may be attributed to the role of Vermicompost in improving the vegetative system of the plant Table (1) when using any of the percentages of Vermicompost in potting media, which leads to an increase in photosynthesis and the accumulation of carbohydrates in the plant, and this is reflected in the characteristics of the flowering system.

The results in Table (5) show an increase in the wet weight of the flowers when fertilizing with Vermicompost by 10% and 15% of the planting medium, and this may be due to the availability of nutrients that improve plant growth, and this is in agreement with **Arancon *et al.* (2008)** who indicated an increase in biomass and flower production in petunias when Vermicompost was added up to 10% of the potting medium.

The data in Tables (1, 2) indicate that plant height and chlorophyll intensity increased significantly with increasing the concentration of chemical fertilizer to 2 g/pot. This is supported by **Thomas and Leong (1981)**, who indicated that the addition of chemical fertilizers containing nitrogen and potassium encouraged the growth of the shabui plant. This is also supported by **Habashi *et al.* (2015)**, who confirmed that the addition of the triple superphosphate fertilizer in liquid form at a concentration of 200 mg.kg-1 to the Shabu plants led to an increase in the leaf content of chlorophyll a and b, as well as **Ojo (1998)** in his study on the plant *Celosia argentea* cock's mane When adding NPK fertilizer at a rate of 90 $kg.ha^{-1}$, it had an effect on most of the vegetative characteristics such as plant height and number of branches.

The data in Table (3) showed that fertilizing the plants with the chemical fertilizer Ibersol and the two concentrations used, 1 and 2 g/pot, led to early flowering of the plants, and this agreed with **(Kumar and Haripriya, 2010)** on early flowering in plants. As **Ahmed *et al.* (2017)** indicated that the increase in the number of branches in the Dawoodi plant when it was treated with NPK fertilizer resulted in an increase in the photosynthesis process and the accumulation of food, which led to improved growth, and then the vegetative growth in the early stages shifted to flowering growth as a result of the nutritional balance, as the plant It contains enough nutrients to produce flowers early, and this is in agreement with what was found by **Sajid and Amin (2014)** on Daoudi.

The result in this experiment can be explained by the fact that the early flowering may be due to the presence of microelements in the components of the chemical fertilizer, which lead to an increase in the

formation of proteins and the manufacture of chlorophyll, which increases the accumulation of nutrients and improves the vegetative and flowering growth of the plant. Table (5) indicated a significant increase in the wet weight of inflorescences and inflorescences with an increase in the concentrations of the chemical fertilizer Ibersol to 2 gm/pot. In the initial stages of plant life, it improves flowering. The length of the inflorescence increased as shown in the results of Table (4) when the chemical fertilizer was added and with the two concentrations used in the experiment.

The results of the interaction between Vermicompost fertilization and chemical fertilizer showed an improvement in the vegetative growth characteristics of the plant when Vermicompost was added at a concentration of 10% or 15% to the pot culture medium overlapping with chemical fertilizer at a concentration of 1 and 2 g/pot. With Ibersol fertilizer at a concentration of 2 g/pot, Table (1). These results agreed with **El Naggar and El Nasharty (2009)**. They indicated an increase in vegetative growth characteristics when field pistachio husk compost was used in the cultivation medium, interfering with NPK fertilizer, as it significantly increased plant height. % of the fertilizer recommendation of chemical fertilizers for the number of leaves, number of branches, and intensity of chlorophyll.

As for the characteristics of flowering growth, it was observed that the plants that were fertilized with Vermicompost at a rate of 15% intertwined with the chemical fertilizer Ibersol at a concentration of 2 g/pot, had earlier flowering and differed significantly from the comparison treatment and the treatment with liquid Vermicompost at a concentration of 0.5 ml / liter with the addition of chemical fertilizer or without the addition of chemical fertilizer as well. For treatment with liquid Vermicompost at a concentration

1 ml / liter and without the addition of the chemical fertilizer Ibersol, and the reason may be due to the lack of access to the nutritional balance to obtain early flowering in plants **(Kumar and Haripriya, 2010)**. The plants that were fertilized with Vermicompost by 15% of the pot culture medium with the addition of chemical fertilizer at a concentration of 2 g/pot were distinguished by increasing the wet weight of the inflorescence and its bearer, Table (5).

Inflorescence length increased in table (4) when Vermicompost fertilizer was added by 10% in the planting medium with fertilization at a concentration of 2 g/pot of chemical fertilizer.

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