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Nada Wahab Ahmed
Thamer Abdullah Zahwan *

Horticulture & Landscape Dept College of Agriculture , Tikrit University- Iraq

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The role of spraying with NPK chemical fertilizer and organic fertilizer on some vegetative and floral indicators and the Active ingredients Origanum majorana

ABSTRACT

The experiment was carried out in the wooden canopy of the Department of Horticulture and Landscaping – College of Agriculture – Tikrit University for the autumn season 2021 , the experiment included studying the effect of tow overlapping factors , the first being spraying with chemical fertilizer NPK (0 , 1.5 gm L-1) and the second factor included the spraying of compost tea fertilizer (poultry manure extract) at levels (0 , 50 , 100 gm L-1) . The experiment designed by randomized complete block design (RCBD) with three replicates , the results showed the superiority of plants that were sprayed with chemical and organic fertilizers over plants that were not sprayed with either of them . The superiority of spraying with chemical fertilizer NPK at the level of F1 (1.5 g L-1) in plant height cm , number of leaves leaf plant-1 , leaf area cm2 , number of flowers flower plant-1 , weight of flowers mg , as it gave the highest values reached (69.25 cm , 2729.37 leaf plant-1 , 792.87 cm2 , 492.99 flower plant-1 , 0.529 mg) straight , the lowest values were for the comparison treatment . Also , the same treatment outperformed in the mineral content of the plant , the percentage of volatile oil and the active ingredients . Also , the treatment of spraying with compost tea was superior in the mentioned characteristics at the level of E2 (100 g L-1) . The results of the interaction showed that there were significant differences in which the treatment was distinguished F1E2 (100g L-1 poultry offal extract + 1.5 g L-1 NPK) it gave the highest values for the traits (plant height 71.84 cm , number of leaves 2978.30 leaf plant-1 , total leaf area 862.92 cm2 , number of flowers 525.44 flower plant-1 , weight of flowers 0.556 mg flower-1 , N 2.520% , P 0.396% , K 2.020% , volatile oil 4.52% , Cymen 13.414 mg , Myrcene 3.129 mg , Sabinen 3.319 mg) , the comparison treatment F0E0 gave the lowest values for the mentioned traits , which amounted to (57.41 cm , 2179.20 leaf plant-1 , 546.54 cm2 , 428.56 flower plant-1 , 0.418 mg flower-1 , 2.346% , 0.296% , 0.997% 3.47% , 11.622 mg , 1.407 mg , 1.508 mg) straight .

INTRODUCTION

Medicinal plants occupy a major place in agricultural production. They are the main source of drugs (Evans and Li , 2003) . Belongs to the family of Lamiaceae, *Origanum majorana* is one of these sources The herbal plant, common name is Marjoram, is perennial and its original habitat was the Mediterranean basin. From there, it was spread to the south of France, England, America, Germany, China, India and some Arab countries such as Syria and Egypt (Skoula and Harbornne, 2002: Verma . et al , 2010)

The large branches of the plant spread on the surface of the ground. The plant has a smell similar to that of mint, and its leaves are used fresh or dried as spices to improve food taste (Renta , 2012) . Plant's oil is medically as a disinfectant killer for microbes because it contains thymol . The

* *Corresponding author: E-mail*: thamir@tu.edu.iq

oil also used to regulate the secretion of Menstruation in women, stimulating the action of bile, and treatment of kidney diseases. In addition, organizes work of the body hormones and protects the liver from damage (Nahid . et al , 2015) . The researchers confirmed the use of the plant as a preservative of local meat due to its antimicrobial and antioxidant susceptibility to contain the compound rosemarnik in addition to aromatic oils (Shaaban, 2010: Mohamad et al , 2011 : Wahab , 2013).

In order to improve plant growth and obtain good total green specifications and a high percentage of volatile oil, a fertilizer containing essential elements for the plant must be followed.

Chemical fertilizers are necessary for plant growth and development. The plant cannot complete its life cycle in the absence of these elements; nitrogen, phosphorus and potassium (Al – Sahaf , 1988) . Nitrogen has an important role in the composition of most vital substances such as enzymes, nucleic acids, energy compounds , proteins and chlorophyll (Abu Dahi and Younis, 1988 : Singh , 2003) Phosphorus has an essential role by involving important compounds such as phospholipids, DNA and RNA as well as in the formation of enzyme accompaniments and energy compounds (Al – Assadi , 2011) . Potassium an element that controls the permeability of the cytoplasmic membranes. It has a role in the opening and closing stomata and helps activate many enzymes (Farhad et al., 2010).

Organic fertilizer increases vegetative growth as it is rich in macro and micro nutrients, particularly nitrogen and phosphorus. These are included in the synthesis of amino and nuclear acids and proteins. Also, they are providing the plant with plant growth regulator such as Auxins , Gibberellin , Cytokinin , and vitamins (Hanafy et al. , 2002 : Kim , 2015) There was lack of studies on Marjoram especially in vegetative growth and volatile oil. Therefore, this study aimed to investigate the effect of chemical and organic fertilizer on vegetative growth , oil content and active ingredients .

MATERIALS AND METHODS

This study was conducted in the Lathhous at the department of Horticulture and Landscape-Tikrit University during the autumn season 2021. *Origanum majorans* seedlings were obtained from one of local nurseries in Baghdad province. The plants with 8-10 cm tall were planted in 12 *8 cm (high*diameter) pots on January 5, 2021. They were transferred to the lath house for acclimatization until February 10, 2021. Then, the plants were moved to larger pots 24 *22 cm (height* diameter) and capacity of 7 liters. Agricultural medium of 1:1 peatmoss: loam was used in these pots. Soil analyzing was conducted in laboratories of the department of Soil and Water Resources, Tikrit University (Table 1).

Table (1): Physical and chemical properties of soil used in the study

Adjective	Unit y	Value
EC	MS	2.1
PH	7.2	
N	PPM	42
P	PPM	11
K	PPM	79.33 068
Ca	PPM	286.0 76
Na	PPM	280.0 095
Gypsum	%	6.710 031
Lime	%	19.2
Sand	%	42.1
Green	%	46.4
Mud	%	11.5
Weaving	Loam	

Design and treatment of the experiment

The field experiment was designed in randomized complete block design with two factors:

The first factor: spraying of NPK fertilizer (F) used it at two levels:

F0 = control (without spraying)

F1 = spraying at 1.5 g L^{-1}.

The second factor was compost tea poultry manure extract (E) used at three levels:

E0 = control (without spraying)

E1 = spraying at 50 g L^{-1} (50 g of poultry manure was added per 1 liter of water. They were left 72 hours with stirring to complete the extraction process . Then, this was filtered and sprayed on the plant shoot)

E2 = spraying of 100 g L^{-1} (100 g of poultry manure was added per 1 liter of water. They were left 72 hours with stirring to complete the extraction process . Then, this was filtered and sprayed on the plant shoot)

The following characteristics were studied:

Plant height: measured at the end of the growing season 8/5/2021 for three plants in each experimental unit and take the rate.

Number of leaves (leaf $plant^{-1}$): it was taken at the end of the growing season 10/5 – 11/5 /2021 for average of three plants in each experimental unit.

Total leaf area (cm^2): according to Patton (1984).

Number of flowers (flower $plant^{-1}$): was calculated at the end of the growing season 16/5 – 17/5/2021 as an average of three plants in each experimental unit.

Weight of flowers (mg) : it was taken at the end of the growing season 16/5 – 17/5/2021 as an average of three plants in each experimental unit.

NPK estimation

Fresh leaves were taken (Morgan, 2006) at the stage of relative stability and stability of the elements (Ibrahim, 2010). They were washed with water to remove dust and were dried at until weight stability. Digestion was conducted using pyrochloric acid and capritic (Al-Sahaf, 1989) to estimate the elements as follows:

Nitrogen percentage (N%)

Estimate nitrogen using micro kjeldahl according to (Page et al. 1982).

Phosphorus percentage (P%):

Phosphorus was estimated using ammonium molybdate and ascorbic acid with the UV-VIS Spectrophotometer Model D 80, at 662 nm wavelength (Olsen and Sommers, 1982).

Potassium percentage (K%):

Potassium was estimated by flam photometer device according to (Al - Domi et al. 1996).

Volatile oils and active ingredient :

Extraction of volatile oils:

Volatile oil of the plant was extracted by adding 20 g of fresh leaves to 100 ml of distilled water and put in the Clevenger for 3 hours. The oil was collected and 20 ml of hexane was added to separate the volatile oil . Then, the oil was saved in refrigerator until the analysis was carried out.

Estimate of active ingredients :

Active ingredients were estimated using gas chromatograph. Ionized flame detector (FID) and a hair separation column type (DM-5Ms) were used. Inert nitrogen gas as a transport gas was used at 100 kpa. The proportion of effective compounds was estimated based on the size of the model and according to the following equation:

$$\text{Concentration of active ingredint} = \frac{Concentration\ of\ standard\ material \times Sample\ area}{\text{Standard material area}} \times \frac{\text{Mitigation factor}}{\text{Sample size}}$$

RESULTS AND DISCUSSION:

Table 2 shows the effect of NPK fertilizer and compost tea in vegetative and flowering characteristics .

Table (2): Effect of NPK and compost tea and their interactions on the of vegetative and flowering characteristics

parameters / treatments	Plant height cm	Number of leaves Leaf plant^{-1}	Total leaf area cm^2	Number of flowers Flower Plant^{-1}	weight of flowers mg flower^{-1}
F0	62.84 b	2505.21 b	579.42 b	457.71 b	0.456 b
F1	69.25 a	2729.37 a	792.87 a	493.99 a	0.529 a
E0	62.28 b	2306.29 c	674.24 b	439.00 c	0.457 c
E1	66.60 a	2694.18 b	679.47 b	477.78 b	0.493 b
E2	69.26 a	2851.40 a	704.73 a	510.77 a	0.526 a
F0E0	57.41 c	2179.20 d	546.54 d	428.56 d	0.418 d
F0E1	64.45 b	2612.00 b c	602.98 c	448.47 c	0.453 c
F0E2	66.67 b	2724.50 b	588.72 c	496.10 b	0.497 b
F1E0	67.16 b	2433.40 c	759.75 b	449.44 c	0.497 b
F1E1	68.75 a b	2776.40 a b	755.95 b	507.08 b	0.533 a b
F1E2	71.84 a	2978.30 a	862.92 a	525.44 a	0.556 a

The numbers have the same letters do not have significant differences according to duncan's test at p= 5%.

From the table noticed increased vegetative growth when spraying NPK fertilizer. These elements collectively or individually affected the growth and development of the plant. Nitrogen works to increase the number and size of cells as it enters the synthesis of protein and nucleic acid , DNA and RNA , which are important in cell division and elongation , as well as its entry into the formation of the amino acid Tryptophan , which is the initiator in the formation of auxin (IAA) has a direct role in cell divisions and elongation , and its deficiency leads to a decrease in protein synthesis and most of the compounds needed for growth , including carbohydrates (Singh , 2003) , it also increases the activity of gibberellins within the plant tissues thus increasing cell division and elongation , which leads to an increase in plant height (Devlin , 2000) as well as its role in stimulating cytokines that stimulate new growth of shoots and then raise the rate of plant growth , which positively affects the increase in the number and size of leaf cells , which results in an increase in the growth and size of the vegetative group represented by the height of the plant , the number of leaves , the leaf area and the number of flowers (Mattson and Schjoerring , 1997) . As for phosphorous , it occupies an important part in the process of photosynthesis and its entry into energy – rich compounds such as ATP , UTP , CTP resulting from the association of three phosphate molecules with a nitrogen base , which leads to the formation of sugars , phosphorous also interferes with nitrogen in the energy compounds NAD needed to convert Acytyl CoA into Gibberellic acid GA3 , which works to increase cell elongation and form a strong radical group with high efficiency in absorbing water and nutrients and also has a role in encouraging flowering (Jundia , 2003) . Potassium is a carbohydrate carrier and an activator of many enzymes , so the plant needs it in high concentrations it plays an active role in improving vegetative growth by assisting in the assimilation of nitrogen and converting amino acids and proteins , which are the building blocks

of growth (Farhad , 2010) . Potassium also increases the rate of growth through its effect in the manufacture of the pigment chlorophyll important in the process of photosynthesis and the formation of carbohydrates , proteins and energy compounds that affect growth (Martin , 2012) . Since potassium had a clear role in cell division and giving a strong vegetative and root system , it had a clear role in increasing the number of leaves and leaf area of the plant (Al – Dulaimi , 2015) . The results of using chemical fertilizers in improving vegetative and flowering growth characteristics are in agreement with what Reza et, al (2011) found that fertilizing *Origanum majorana* with NPK fertilizer led to a significant increase in plant production and green yield .

Also , spraying with compost tea contributed to an increase in vegetative and flower growth these results were in agreement with (Al – Abbasi and Kamal , 2011) . The superiority of organic fertilization in the vegetative growth characteristics of plants is attributed to the role of spraying with compost tea as it is rich in macro and micro elements nitrogen and phosphorous , which are included in synthesis of amino and nucleic acids and proteins and processing plants with growth stimulants such as Auxins , Gibberellins , Cytokinins , Vitamins and Organic acid (Kim , 2015) which encourages the process of cell division and elongation and activates microorganisms that secrete some substances similar to plant hormones and as a result contribute to an increase in cell division and an increase in their size , which results in an increase in vegetative growth indicators (Al – Omrani , 2010) . The results of our study agreed with what Hendawy and Khalid (2011) : Ahmed et,al (2019) found in their study on the chamomile plant , the superiority of spraying compost tea by recording the highest values in the average plant height , number of leaves , leaf area , number and weight of flowers . As for the effect of the interaction between these two factors , NPK and compost tea in increasing vegetative and flowering growth , it is due to their joint role in providing an ideal environment for plant growth and providing it with its needs of nutrients and other requirements , which prompted the direction of improving the available growth factors in a better way . The vegetative and floral aggregate .

Table (3) shows that the plants outperform NPK chemical fertilizer and compost tea . Treatment F1E2 (100 g L^{-1} compost tea + 1.5 g L^{-1} NPK) was superior in mineral content, volatile oil, and active ingredients .

Table (3): Effect of NPK and compost tea and their interactions on mineral content, volatile oil and active ingredients in *Origanum majorana*

parameters / Treatments	N %	P %	K %	volatile oil %	Cymen gm	Myrcene gm	Sabinen gm
F0	2.371 a	0.277 b	1.329 b	3.68 b	12.022 b	1.850 b	1.973 b
F1	2.452 a	0.358 a	1.782 a	4.26 a	13.015 a	2.940 a	3.110 a
E0	2.442 a b	0.305 b	1.326 c	3.74 c	12.092 c	2.015 c	2.148 c
E1	2.343 b	0.304 b	1.531 b	4.01 b	12.524 b	2.440 b	2.577 b
E2	2.450 a	0.344 a	1.811 a	4.17 a	12.941 a	2.731 a	2.901 a
F0E0	2.346 c	0.296 b	0.997 d	3.47 e	11.622 e	1.407 f	1.508 f
F0E1	2.388 a b c	0.242 c	1.390 c	3.77 d	11.977 d	1.810 e	1.930 e
F0E2	2.380 c	0.292 b	1.601 b	3.81 d	12.467 c	2.332 d	2.482 d
F1E0	2.537 a	0.313 b	1.655 b	4.00 c	12.561 c	2.622 c	2.788 c
F1E1	2.298 c	0.365 a	1.672 b	4.25 b	13.071 b	3.069 b	3.223 b
F1E2	2.520 a b	0.396 a	2.020 a	4.52 a	13.414 a	3.129 a	3.319 a

Numbers have the same letters do not have significant differences according to duncan's test at p=5%.

The increase in volatile oil in the plant, which is reflected in the increase of active ingredients , was resulted by the effect of NPK. Nitrogen increased the activity of gibberellins within the tissues of the plant. This led to cell division and elongation as it increases the permeability of cell wall to enter larger amount of water and nutrients. In turn, increases growth rate and protein composition stimulated by cytokinins , which stimulates absorption of potassium. As a result, increase the effective role of nitrogen to increase growth such us leaf area. This positively reflected in the photosynthesis products including carbohydrates, accumulation of processed nutrient , and metabolic compounds (Martin , 2012). Phosphorus has an important role in the oxidation and reduction process by entering the synthesis of amino and nucleic acids and co-enzyme. This is controlling the vital interactions of the process of respiration and photosynthesis (Muhammad, 1985 : Al-Nuaimi, 1999). Potassium plays an important role in the representation of proteins, carbohydrates and amino acids. These elements are all involved in increased growth parameters , which represents an increase in leaf area . In addition, increased in the number and size of glandular hair containing volatile oil which led to an increase in the amount of oil produced (Mohammed and Younis, 1991: Cseke et al., 1997).

Compost tea was significantly superior in the volatile oil and active ingredients . This can be due to the organic fertilization that provided the plant with nutrient requirements. The fertilizer increased the efficiency of vital processes, especially photosynthesis and respiration. Thus, increased accumulation of carbohydrates and production of secondary compounds, including volatile oil (Al - Bayati, 2003: Shaheen and Nakhlawy, 2008: Said-Al ahl and Hussin, 2010)

Two-factor interaction between NPK and compost tea provided the necessary nutrients for plant growth. This increased the growth, which increased volatile oil and number of active ingredients . Consequently, increased accumulation of carbohydrates and secondary metabolism compounds including volatile oil. These results agreed with (Kandil , 2002)

CONCLUSIONS

1 – Spraying NPK fertilizer led to an increase in most of the characteristics studied, the percentage of volatile oil and the active ingredients at 1.5 g L^{-1} .

2 – Spraying with compost tea resulted in the superiority of most of the characteristic of vegetative growth , the percentage of volatile oil and the active ingredients at 100 g L^{-1} .

3 – The study showed that the interaction between the studied factors had a positive effect in improving most of the characteristics of vegetative growth , the percentage of volatile oil and the active ingredients .

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دور الرش بالسماد الكيمياوي NPK والعضوي في بعض المؤشرات الخضرية والزهرية والمادة الفعالة لنبات البردقوش

Origanum majorana

ندى وهب احمد **ثامر عبدالله زهوان**

قسم البستنة وهندسة الحدائق – كلية الزراعة – جامعة تكريت

الكلمات المفتاحية:
الأسمدة الكيماوية ، شاي السماد ، المحتوى المعدني ، الزيت الطيار.

الخلاصة

نفذت التجربة في الظلة الخشبية التابعة لقسم البستنة وهندسة الحدائق – كلية الزراعة – جامعة تكريت للموسم الخريفي 2021 تضمنت التجربة دراسة تأثير عاملين متداخلين الاول الرش بالسماد الكيمياوي NPK (0 ، 1.5 غم لتر-1) وشمل العامل الثاني رش سماد شاي الكومبوست (مستخلص مخلفات الدواجن) بالمستويات (0 , 50 , 100 غم لتر-1) . صممت التجربة بنظام القطاعات العشوائية الكاملة RCBD وبثلاث مكررات وبينت النتائج تفوق النباتات التي رشت بالسماد الكيمياوي والعضوي على النباتات التي لم يرش لها أي منهما اذ تفوق الرش بالسماد الكيمياوي NPK عند مستوى F1 (1.5 غم لتر-1) في ارتفاع النبات سم ، عدد الاوراق ورقة نبات-1 ، المساحة الورقية سم2 ، عدد الازهار زهرة نبات-1 ، وزن الازهار ملغم زهرة-1) اذ اعطت اعلى قيم بلغت (69.25 سم ، 2729.37 ورقة نبات-1 ، 792.87 سم2 ، 493.99 زهرة نبات-1 , 0.529 ملغم زهرة-1) على التوالي ، والقيم الاقل كانت لمعاملة المقارنة ، وكذلك تفوقت المعاملة ذاتها في المحتوى المعدني للنبات ونسبة الزيت الطيار والمواد الفعالة ، وكذلك تفوقت معاملة الرش بمستخلص مخلفات الدواجن في الصفات المذكورة عند مستوى معاملة (E2 100 غم لتر-1) . وكانت نتائج التداخل وجود فروقات معنوية تميزت فيها المعاملة (F1E2 100 غم لتر-1 مستخلص مخلفات الدواجن + 1.5 غم لتر-1 NPK) اذ اعطت اعلى قيم للصفات (ارتفاع النبات 71.84 سم ، عدد الاوراق 2978.30 ورقة نبات-1 ، معدل المساحة الورقة 862.92 سم2 ، عدد الازهار 525.44 زهرة نبات-1 ، وزن الازهار 0.556 ملغم زهرة-1 ، نيتروجين 2.520 % ، فسفور 0.396 % ، بوتاسيوم 2.020 % ، الزيت الطيار 4.52 % ، Cymen 13.414 ملغم ، Myrcene 3.129 ملعم ، Sabinen 3.319 ملغم) واعطت معاملة المقارنة F0E0 اقل قيم وبلغت (57.41 سم ، 2179.20 ورقة نبات-1 ، 546.54 سم2 ، 428.56 زهرة نبات-1 ، 0.418 ملغم زهرة-1 ، 2.346 % ، 0.296 % ، 0.997 % ، 3.47 % ، 11.622 ملغم ، 1.407 مبغم ، 1.508 ملغم) على التوالي .