Effect of pinching, kinetin, and humic acid on Qualitative and quantitative traits of, *Rosmarinus officinalis* L.

Amal Imad Ali Obaid Al-Shammari Baydaa Rasheed Hilo

College of Agriculture - Al-Qasim Green University - Department of Horticulture and Landscape Engineering

Abstract:

The experiment was conducted in lathhouse of the Department of Horticulture and Landscape Engineering/College of Agriculture/Al-Qasim Green University in autumn season (2022-2023), where rosemary seedlings were used.At the age of one year, of uniform development, the experiment included two factors: the first factor (pinching), where it is done Half of the plants were stranded, symbolized by the symbol P1, and the rest of the plants were left without pinching, P0, and the factor second (adding humic acid and spraying kinetin), where the effect of adding humic acid was studied.For the soil according to the concentrations (0,4,8 ml/L) and symbolized by (H0, H1, H2), the plants were sprayed with kinetin and the treatment was conducted by spraying on the leaves until they were completely wet with concentrations of 0.50, 100 mg/L) and symbolized by (K0). K1K2), and it was conducted as a factorial experiment (3*3*2)) in a split-plot arrangement according to a randomized complete block design (R.C.B.D) and with three replicates, where each replicate contains 18 treatments with five seedlings for each experimental unit. The main plot are pinching, and the humic concentrations and kinetin concentrations and their interactions are represented. sub plot. The averages were compared using the Least Significant Difference (LSD) test at the 5% level. The results showed the following: The pinching achieved significantly excelled in the studied physical traits of the volatile oil and the active compounds, including: - Specific gravity of the oil (0.81 mg), Myrcene compound (5.81%), and Camphor compound (14.74). (%), and the a-pinene compound (19.59%), and the treatment without pinching achieved excelled on the pinching treatment in the percentage of oil in the leaves amounting to 0.68%. Also, adding humic acid to the soil had a significant effect on the plants treated with humic acid at a concentration (8 ml/ liter) as it excelled in giving the best rates in traits of- :The specific gravity of the volatile oil is (0.77 mg), the percentage of oil in the leaves is 0.87%), and the active compounds of the oil include Myrcene compound (6.19%), and Camphor compound and the compound a-pinene (19.70%). The spraying treatment with kinetin at a concentration (100 mg/L) achieved significantly higher values in the physical traits of the volatile oil and the active compounds of the oil, including- :The percentage of oil in the leaves is (0.74%), and the

ISSN 2072-3857

specific weight of the oil is 0.81 mg. Spraying with kinetin also achieved the highest values in compounds, including Myrcene (5.87%), Camphor (14.82%), a-pinene (19.70%), and the interaction The combination of the three factors: spraying P1, adding humic acid at a concentration of 0, and spraying with kinetin at a concentration of 0 gave significantly the highest values for the following traits:The density of the volatile oil is (0.14 mg. µl $^{-1}$), and the specific gravity of the volatile oil is (0.92 mg). Also, the P1 impregnation parameters, the addition of humic at a concentration of (8 ml/l) and spraying with kinetin at a concentration of 0 achieved the highest values for the leaf content of the oil density (0.14 mg. µl $^{-1}$), also the impurity parameters (P1), humic (8 ml/l) and spraying with kinetin (50 mg/l) gave the highest values that significantly affected the density of the oil (0.14 mg). µl^{-1}), and the treatment that gave the highest values for spraying P1 and humic at a concentration of (8 ml/L) and spraying with kinetin at a concentration of 100 mg/L was achieved significantly in the Myrcene compound (6.64%), and the compound Camphor (15.73%), and a-pinene (20.83%). The treatments without P0, humic (8 ml/L) and kinetin (100 mg/L) also achieved the highest values for the percentage of oil in the leaves (1.34%.(

Keywords: rosemary, pinching, humic acid, kinetin, volatile oil

Introduction:

The rosemary plant (*Rosmarinus officinalis* L.) is one of the perennial and evergreen shrubs of the Lamiaceae family. Its original home is the Mediterranean basin and southern Europe, where it grows wild in southern Europe, where its cultivation and spread expanded from there, as well as in most countries of the world. Spain, France, and Tunisia are among the most important countries that produce the oil extracted from this plant[12] . The cultivation of medicinal and aromatic plants in general, and rosemary in particular, is one of the alternative economic crops whose cultivation has expanded on a large scale recently due to the suitability of the natural conditions and circumstances. The environmental benefits of its cultivation, in addition to the good economic returns resulting from it. Therefore, attention and development of the cultivation of these plants must be encouraged for their important role in future agricultural development. Because they contain tannins, vitamins B9, B6, B3, B2, B1, vitamin C, and minerals such as iron, calcium, zinc, and potassium. They also contain antioxidants and Contains volatile oils that contain the compounds borniol, cineol, camphor, camphene and linalool. It also contains flavonoids and rosmarinic acid. Rosemary is used as a spice, appetizer, and taste enhancer. It is used in salads, desserts, meat and their products, as well as fish and vegetables, making soups, and preserving canned meat and fish products. Pure oil is also

ISSN 2072-3857

used in perfumery, cosmetics and shampoos to strengthen hair. It is used in skin care products, such as skin, face, and hand care. It is used in the manufacture of soap and other detergents because it contains a distinctive smell. Modern agriculture is moving towards avoiding all pollutants by relying on the use of natural materials such as organic and biofertilizers instead of chemical fertilizers[5] The process of pinching (pinching the growing top) is one of the important agricultural operations that leads to an increase in the number of plant branches and breaking the apical dominance, which stimulates the growth of lateral shoots significantly[1,17] which affects the shape of the plant and increases the number of branches and area. Leafy, so many plant breeders perform mulching to increase the density of the plant .Cytokinins play a fundamental role in stimulating the process of cell division and specialization in partnership with auxins. Their importance also appears in many other physiological processes, such as in the phenomenon of apical dominance, which affects the process of plant branching. The first cytokinin compound discovered is Kinetin. This compound is not found naturally in plants. In fact, it is one of the products of the thermal decomposition of adenine. The discovery of kinetin encouraged the use of industrial synthesis of hundreds of similar compounds. However, kinetin is one of the most common and used substances in studies on the physiological effects of cytokinins [17] . Kinetin works on... Inhibiting apical dominance in the plant, stimulating the growth of lateral shoots, the occasional expansion of cells, forming the apparent appearance of the plant, delaying senescence, and preserving the green color (Al-Assadi, 2019(One of the organic fertilizers used is humic acid, which is considered a complex substance that results from the decomposition of plant and animal materials through the humidification process. These substances consist mainly of humic acid, fulvic acid, and humin. These substances have an essential role in soil fertility and plant nutrition, and humic acids have a positive effect on growth. The plant because it helps in the permeability and stimulation of vitamins inside the cells[13] .where the rosemary plant is sprayed with humic acid, it will significantly improve the growth of the shoots.[10]

The aim of the experiment: Studying the effect of pinching, humic acid, and kinetin on the physical and chemical traits of rosemary plants.

Materials and methods

The experiment was conducted as a factorial experiment (2 × 3 × 3) with a split-block arrangement according to a completely randomized block design (Complete Randomized Blocks Design R.C.B.D) and with three replicates, where each replicate contained 18 treatments with five seedlings for each

ISSN 2072-3857

experimental unit. The folds represented the main panels and the humic concentrations represented Kinetin concentrations and their interactions, secondary panels. The means were compared using the least significant difference (LSD) test at the 5% level.The experiment included a study of two factors:

The main factor: pinching

The growing top of the rosemary seedlings was cut off, with half of the plants cut off and denoted by the symbol P1, and the rest of the plants were left uncut and denoted by the symbol P0.

The second factor: adding humic acid and spraying kinetin

Spraying with kinetin:-

The treatment was conducted by spraying the leaves until they were completely wet, as follows:

1) control without using kinetin, symbolized by K0

2) Use kinetin at a concentration of 50 mg/L, symbolized by K1

3) Use kinetin at a concentration of 100 mg/L, symbolized by K2

The spraying was done with Kinetin twice, the first spraying was done immediately after the renovation on 10/26/2022.

The second spraying was done a month after the first spraying, on 11/27/2022, and humic acid was added to the soil according to the following concentrations.

1- Without addition and is symbolized by the symbol H0

2- Add humic acid at a concentration of 4 ml/liter, symbolized by the symbol H1

3- Add humic acid at a concentration of 8 ml/liter, symbolized by the symbol H2

Addition of humic acid in three additions, the first addition immediately after plastering, on the date

10/12/2022, and the second addition is a month after the first addition on 11/12/2022, as well as the third addition on 12/12/2022.

Measurements were taken of the physical properties of the volatile oil

Extraction of volatile oil

The process of extracting the volatile oil was carried out using a water distillation device (Clevenger) connected to a 1-liter circular glass flask. The plant leaves to be distilled were ground and the volatile oil was extracted from them while they were dry. 50 g of them were placed in the circular glass flask and 500 ml of water was added. The process of hydrodistillation was carried out by heating the flask, and the temperature did not rise above 70°C. The distillation process continued for 5 hours for each sample of the rosemary plant until the largest possible amount of oil was obtained.

Then the oil was separated to get rid of the water and the oil was placed in opaque bottles with a tight lid after closing them well and

ISSN 2072-3857

placed at a temperature of 4°C until the quantity and quality of the volatile oils were tested and diagnosed [8]

Percentage of oil in leaves %

The weight of the oil was calculated after extraction using a sensitive balance according to the following equation:[9]

Percentage of oil%=

$$\frac{The\ weight\ of\ the\ oil\ produced\ from\ the\ sample(g)}{Weight\ of\ leaf\ sample\ (g)} \times 100$$

Specific gravity of oil

The specific gravity of each oil sample from each treatment was estimated by taking a volume of 100 microliters of volatile oil in a fine volumetric pipette and recording the weight of the volume using a sensitive balance. The specific gravity values were calculated at a temperature of 25 °C for each sample by dividing the weight of that volume of oil by the weight of the same volume of water. Distilled and at the same temperature.

Density of volatile oil=

$$\frac{Weight\ of\ the\ volatile\ oil\ sample\ (volume\ 100\ \mu l)\ (mg)}{Oil\ sample\ volume\ (100\ \mu l\ volume)\ (mg)}$$

Density of volatile oil (mg.µl^{-1})

The density of each oil sample was calculated by taking a volume of 200 microliters of oil for each treatment using a micropipette at room temperature (25°C), then weighing and applying the following equation:

((mg)(100 microliters) oil sample weight)/((100 microliters) oil sample volume)=pilot oil density

Estimation of oil components (vehicle estimation)

The analyzes were conducted at the Ministry of Science and Technology/Department of Environment and Water using a gas chromatography device (GC), Japanese type Shimazu, model 2010, flame ionization detector type (FID), separation column (0.25 mm × 0.25 mm × 30 m) (54- SE), injection area temperature 280 degrees. Celsius, the detector temperature is 310 degrees Celsius, and the retention time and package area were determined for both the standard model and the sample after being injected into the device at a concentration of 3 ppm for both the standard model and the sample. The concentration for each compound is determined by comparing the sample package area with the standard model package area. Which were injected under the same conditions and the process was repeated on all samples, and the concentration of the compounds was calculated according to the following equation

Results and discussion:

Percentage of oil in leaves %

The results in Table (1) indicate that there are significant differences between the treatments for rosemary plants.Where P0 gave the highest

ISSN 2072-3857

percentage of oil, amounting to 0.68%, compared to treatment P1, which gave the lowest percentage of oil, amounting to 0.63%.As for spraying with kinetin, there were significant differences between treatment K2, which gave the highest percentage, which amounted to 0.74%, and treatment K0, which gave the lowest oil percentage, as it amounted to 0.51%.As for the effect of humic, the H2 treatment, which gave the highest percentage of oil, was superior, reaching0.87%, and treatment H0 gave the highest percentage of oil, reaching 0.50%.The bi-interactions between mulching and spraying with kinetin led to a significantly excelled between plants.Treatment P0K2 was characterized by giving the highest percentage of oil, amounting to 0.82%, and treatment P0K0.It gave the lowest percentage of oil, reaching 0.48%, as was the combined effect of humic and spray.Kinetin had a significant effect on the percentage of volatile oil, as the treatment gave a higher H2K2 The percentage of oil reached 1.01%, compared to treatment H2K0, which gave the lowest percentage For volatile oil, it amounted to 0.3417% The interactions between pinching and humic resulted in a significant increase in the percentage of volatile oil .The P0H2 treatment gave the highest percentage of oil, reaching 1.08% P0H0 is the lowest percentage of oil, reaching 0.43%. As for the three-way interaction between the study factors, we note a significantly excelled between treatments, where Treatment P0H2K2 gave the highest percentage of oil, reaching 1.34%.Treatment P0H0K0 had the lowest percentage of oil, reaching 0.29%.

ISSN 2072-3857

Table (1) The effect of pinching, humic acid, kinetin, and their interactions on the oil percentage of rosemary plants for the autumn season 2022-2023.

K x P	(H)			(K)	(P)
	(H2)	(H1)	(H0)		
0.48	0.66	0.47	0.29	(K0)	(P0)
0.75	1.23	0.59	0.45	(K1)	
0.82	1.34	0.54	0.57	(K2)	
0.55	0.66	0.61	0.39	(K0)	(P1)
0.67	0.63	0.73	0.65	(K1)	
0.66	0.68	0.66	0.64	(K2)	
0.03	0.056			L.K.D 0.05	
(P)	(P×H)				
0.68	1.08	0.53	0.4367	(P0)	
0.63	0.65	0.67	0.5589	(P1)	
0.02	0.03			L.S.D 0.05	
(K)	(K×H)				
0.51	0.66	0.54	0.3417	(K0)	
0.71	0.93	0.66	0.5483	(K1)	
0.74	1.01	0.6	0.6033	(K2)	
0.02	0.39			L.S.D 0.05	
	0.87	0.60	0.50	(H)	
	0.02			L.S.D 0.05	

Specific gravity of oil

The results in Table. (2) show excelled between the pinching treatments for rosemary plants, where Pinching resulted in superiority in treatment P1, which gave the highest rate of specific gravity of the oil It reached 0.81 mg, compared to treatment P0, which gave the lowest rate of specific gravity of the oil, as It reached 0.59 mg, while spraying with kinetin gave the highest rate of specific gravity of the volatile oil. For treatment K2, it amounted to 0.81 mg, compared to treatment K0, which gave the lowest average specific gravity of the volatile oil, as it amounted to 0.59 mg.As for the effect of humic acid, it led to a significantly excelled, as the H2 treatment gave the highest rate The specific weight of the volatile oil reached 0.77 mg, and the H0 treatment gave the lowest weight rate. The quality of the volatile oil reached 0.61 mg, as the bi- interactions between pinching and spraying led to kinetin, there was a significant effect among plants, as the P1K2 treatment gave the highest weight rate The specific gravity of the oil reached 0.87 mg, compared to the treatment P0K0, the lowest rate of specific gravity of the oil.It reached 0.42 mg, and the interactions between humic and spraying with kinetin led to a significantly excelled in the specific gravity of the volatile oil, the H2K2 treatment gave the

ISSN 2072-3857

highest specific gravity rate.The oil reached 0.87 mg, and the H2K2 treatment had the lowest specific gravity of the oil. It reached 0.39 mg. The combined effect between pinching and humic also had a significant impact on The specific gravity of the volatile oil, as treatment H2P1 gave the highest rate of specific gravity of the oil It reached 0.81 mg, and the H2P1 treatment had the lowest specific gravity rate, reaching 0.43 mg. In the three-way interaction between the study factors, we note that there is a significantly excelled between treatments where they are given Treatment P1H0K2 had the highest specific gravity of the volatile oil, reaching 0.92 mg, compared to treatment P0H0K0, which gave the lowest average specific gravity of the volatile oil, reaching 0.17 mg.

Table 2) The effect of pinching, humic acid, kinetin, and their interactions on the oil specific gravity of rosemary plants for the autumn season 2022-2023.

K x P	(H)			(K)	(P)
	(H2)	(H1)	(H0)		
0.42	0.54	0.55	0.17	(K0)	(P0)
0.61	0.83	0.57	0.43	(K1)	
0.75	0.88	0.67	0.70	(K2)	
0.77	0.83	0.85	0.63	(K0)	(P1)
0.78	0.73	0.75	0.85	(K1)	
0.87	0.87	0.83	0.92	(K2)	
0.029	0.052			L.K.D 0.05	
(P)	(P×H)				
0.59	0.75	0.59	0.43	(P0)	
0.81	0.80	0.81	0.79	(P1)	
0.017	0.029			L.S.D 0.05	
(K)	(K×H)				
0.59	0.69	0.70	0.39	(K0)	
0.69	0.78	0.66	0.64	(K1)	
0.81	0.87	0.75	0.80	(K2)	
0.021	0.036			L.S.D 0.05	
	0.77	0.70	0.61	(H)	
	0.021			L.S.D 0.05	

Density of volatile oil (mg.µl^{-1})

The results in Table (3) indicate the superiority of the coefficients, as the bilateral interactions between.pinching and humic indicated a significantly excelled among the plants where the P1H2 treatment was characterized by giving The highest average oil density reached 0.20 mg. µL^{-1} compared to treatment P0H0 which It gave the lowest average oil density, reaching 0.15 mg.µl-1.In the bi- interaction between the study factors, we note that there is a significant superiority between the treatment

ISSN 2072-3857

where they were given treatment P1H0K0, P1H2K0, P1H2K1, and P1H0K2 gave the highest average density oil, which amounted to 0.20 mg.µl^{-1} compared to treatment P0H0K0, which gave the lowest rate for all oil, amounting to 0.14 mg.µl^{-1}.

Table (3) The effect of pinching, humic acid, and kinetin and their interactions on the density of the volatile oil (mg.µl-1) of rosemary plants for autumn season 2022-2023.

K x P	(H)			(K)	(P)
	(H2)	(H1)	(H0)		
0.17	0.17	0.19	0.14	(K0)	(P0)
0.16	0.15	0.18	0.16	(K1)	
0.18	0.18	0.18	0.17	(K2)	
0.19	0.20	0.18	0.20	(K0)	(P1)
0.19	0.20	0.19	0.17	(K1)	
0.19	0.19	0.19	0.20	(K2)	
N.S	0.034			L.K.D 0.05	
(P)	(P×H)				
0.17	0.17	0.18	0.1578	(P0)	
0.19	0.20	0.19	0.1911	(P1)	
N.S	0.020			L.S.D 0.05	
(K)	(K×H)				
0.18	0.19	0.19	0.1683	(K0)	
0.18	0.1783	0.185	0.1667	(K1)	
0.19	0.185	0.185	0.1883	(K2)	
N.S	N.S			L.S.D 0.05	
	0.1828	0.1856	0.1744	(H)	
	N.S			L.S.D 0.05	

Myrcene compound (%)

It is clear from the results of Table No. (4) that there is a significant effect between the pinching treatment of the rosemary plant Where pinching P1 gave the highest rate for the Myrcene compound, reaching 5.81%. Compared to treatment P0, which gave the lowest rate of Myrcen compound, reaching 5.15%. As for the effect of spraying rosemary plants with kinetin, treatment K2 gave the highest rate of the compound Myrcen, which reached 5.87%, compared to treatment K0, which gave the lowest values, reaching 5.11%. While the effect of adding humic to the H2 treatment resulted in the highest rate of Myrcen compound, reaching 6.19%, compared to treatment H0, which gave the lowest rate of the Myrcene compound, reaching 4.662%, as for the bi- interaction between pinching and spraying with kinetin, it was There are differences between transactions, as transaction P1K2 gave the highest rate of 6.14%. Compared to treatment P0K0, which gave the lowest rate of Myrcene compound, reaching

4.76%.The interactions between humic and spraying with kinetin led to significant differences in the Myrcene compound, as It reached 6.458%, compared to treatment H0K0, which gave the lowest percentages of the compound. Myrcene, reaching 4.263%. The combined effect between humic and pinching also had a significant impact on Myrcene compound, where treatment P1H2 gave the highest rate of the compound, amounting to 6.51%, with a significant difference from treatment P0H0, which gave the lowest rate of Myrcene compound, amounting to 4.471%.In the bi- interaction between the study factors, we notice a significant superiority, as treatment P1H2K2 gave the highest percentage of the Myrcene compound, reaching 6.64%, compared to treatment P0H0K0, which gave the lowest percentage of the compound, reaching 4.18%.

Table 4) The effect of pinching, humic acid, and kinetin and their interactions on the Myrcene compound (%) of rosemary plants for autumn season 2022-2023

K x P	(H)			(K)	(P)
	(H2)	(H1)	(H0)		
4.76	5.47	4.63	4.18	(K0)	(P0)
5.08	5.92	4.83	4.49	(K1)	
5.61	6.28	5.79	4.75	(K2)	
5.47	6.38	5.69	4.35	(K0)	(P1)
5.81	6.51	6.07	4.86	(K1)	
6.14	6.64	6.43	5.35	(K2)	
0.17	0.29			L.K.D 0.05	
(P)	(P×H)				
5.15	5.89	5.08	4.47	(P0)	
5.81	6.51	6.06	4.85	(P1)	
0.10	0.17			L.S.D 0.05	
(K)	(K×H)				
5.11	5.92	5.16	4.26	(K0)	
5.45	6.22	5.45	4.67	(K1)	
5.87	6.45	6.11	5.04	(K2)	
0.12	0.21			L.S.D 0.05	
	6.19	5.57	4.66	(H)	
	0.12			L.S.D 0.05	

camphor compound (%)

The results in Table (5) indicate that there is a significant effect between the pinching treatment of the rosemary plant Where pinching P1 gave the highest rate of camphor compound, reaching 14.74%.Compared to treatment P0, which gave the lowest rate of camphor compound, reaching 14.05%. As for the effect of spraying rosemary plants with kinetin, treatment K2 gave the highest rate of

ISSN 2072-3857

the compound camphor, which reached 14.82%, compared to treatment K0, which gave the lowest values, reaching 14.00%. While the effect of adding humic to treatment H2 gave the highest rate For the camphor compound, it reached 15.16%, compared to treatment H0, which gave less The camphor compound rate reached 13.53%, as for the bi- interaction between pinching and spraying with kinetin. There were differences between the treatments, where the treatment gave P1K2 The highest rate reached 15.11%, compared to treatment P0K0, which gave less of camphor compound reached 13.63%. The interactions between humic and spraying with kinetin led to significant differences in the camphor compound The H2K2 treatment gave the highest rate, reaching 15.46%, compared to the treatment

H0K0, which gave the lowest percentage of camphor compound, reaching 13.15%. The combined effect between humic acid and pinching also had a significant effect on the camphor compound, as it gave treatment P1H2 had the highest compound rate of 15.59%, with a significant difference from Treatment P0H0 gave the lowest rate of camphor compound, reaching 13.409%. In the triple interaction between the study factors, we notice a significantly excelled where the treatment was given P1H2K2 had the highest percentage of camphor, reaching 15.73%, compared to treatment P0H0K0, which gave the lowest percentage of the compound, reaching 13.09%.

Table 5) The effect of pinching, humic acid, kinetin, and their interactions on the camphor compound (%) of rosemary plants for autumn season 2022-2023

K x P	(H) Humic acid			(K)	(P)
	(H2)	(H1)	(H0)		
13.63	14.23	13.57	13.09	(K0)	(P0)
14.00	14.77	13.89	13.33	(K1)	
14.54	15.20	14.60	13.81	(K2)	
14.37	15.39	14.50	13.21	(K0)	(P1)
14.75	15.66	14.88	13.73	(K1)	
15.11	15.73	15.51	14.07	(K2)	
0.08	0.14			L.K.D 0.05	
(P)	(P×H)				
14.05	14.73	14.02	13.409	(P0)	
14.74	15.59	14.96	13.67	(P1)	
0.05	0.08			L.S.D 0.05	
(K)	(K×H)				
14.00	14.81	14.04	13.15	(K0)	
14.38	15.22	14.38	13.52	(K1)	
14.82	15.46	15.05	13.94	(K2)	
0.05	0.10			L.S.D 0.05	
	15.16	14.49	13.53	(H)	

ISSN 2072-3857

a-pinene compound (%)

The results in Table (6) indicate that there is a significantly excelled between the pinching treatments for rosemary plants Where pinching P1 gave the highest rate of a-pinene compound, reaching 19.59%., compared to treatment P0, which gave the lowest rate of a-pinene compound, reaching 17.47%, as for the effect of spraying rosemary plants with kinetin on the treatment K2 had the highest rate of a-pinene compound, reaching 20.0%, compared to treatment K0, which It gave the lowest values, reaching 17.5%. While the effect of adding humic to treatment H2 gave the highest rate of a-pinene compound, which reached 19.70%, Compared to treatment H0, it gave the lowest rate of a-pinene compound, reaching 15.97%. As for the bi- interaction between pinching and spraying with kinetin, there were differences between the treatments P1K2 gave the highest rate, reaching 20.32%, compared to treatments P0K0, which gave the lowest rate for a-pinene, reaching 15.46%. The interactions between humic and spraying with kinetin led to significant differences in the a-pinene compound Treatment H2K2 gave the highest rate, reaching 20.56%, compared to treatment H0K0, which gave the lowest percentage of a-pinene, reaching 13.20%. The combined effect between humic acid and pinching also had a significant effect on a-pinene, as treatment gave P1H2. The highest rate of the compound was 4.4%, with a significant difference from treatment P0H0, which gave the lowest rate of a-pinene, which amounted to 2.45%. In the triple interaction between the study factors, we notice a significant effect where the treatment was given P1H2K2 had the highest percentage of a-pinene, reaching 20.83%, compared to treatment P0H0K0, which gave the lowest percentage of the compound, reaching 8.14%.

ISSN 2072-3857

Table (6): The effect of pinching, humic acid, kinetin, and their interactions in a compound a-pinene (%) for autumn season rosemary plants for autumn season 2022-23

K x P	(H)			(K)	(P)
	(H2)	(H1)	(H0)		
15.46	19.63	18.61	8.14	(K0)	(P0)
19.26	20.10	19.28	18.39	(K1)	
19.65	20.29	19.79	18.88	(K2)	
19.49	20.46	19.74	18.27	(K0)	(P1)
19.92	20.85	20.15	18.77	(K1)	
20.32	20.83	20.63	19.48	(K2)	
0.063	0.11			L.K.D 0.05	
(P)	(P×H)				
17.47	20.05	19.18	13.20	(P0)	
19.59	20.48	19.72	18.58	(P1)	
0.04	0.064			L.S.D 0.05	
(K)	(K×H)				
17.5	20.04	19.17	13.20	(K0)	
19.6	20.47	19.71	18.58	(K1)	
20.0	20.56	20.21	19.18	(K2)	
0.045	0.078			L.S.D 0.05	
	19.70	16.98	15.97	(H)	
	0.045			L.S.D 0.05	

Plant pinching have a significant effect in increasing the percentage of essential oil compared to non- pinching plants. The reason for this may be due to the role of pinching in improving some of traits of vegetative growth represented by lateral branches. This increases the efficiency of photosynthesis by increasing the tissue content of total dissolved carbohydrates, and this is reflected in Positively increased oil yield and agreed with the findings of[6,7] Kinetin is one of the growth regulators that consists of a pyrene ring. It works to increase the duration and rate of photosynthesis and the manufacture of carbohydrates and their transfer to storage places represented by flower inflorescences, which leads to an increase in the active substances that are secondary products of the products of photosynthesis and leads to an increase in the active compounds in the extracted volatile oils[3] .It is also noted that spraying with kinetin has a significant effect in increasing the percentage of the volatile oil and the active medicinal substance, as the effect increases as the concentration of kinetin increases. It may also justify the effective role of kinetin in transferring carbohydrates from the leaves to the seeds (Sink), and this is what was found by [18] in the Lavandula officinalis plant, and [16] in the black cumin plant.The

ISSN 2072-3857

significant increase in traits of the volatile oil, which includes oil yield and physical characteristics, due to the effect of spraying humic acid, magnesium, and zinc, may be due to the fact that humic acid contains in its composition carbon, hydrogen, oxygen, and nitrogen in different proportions, resulting in compounds with varying molecular weights. These substances, when added to the shoots, play a role in It is essential for plant nutrition, which is reflected in improved growth through its effect on the processes of photosynthesis and respiration[11] . This positive role of humic acid in plant growth is reflected in the increase in the percentage of volatile oils [15] . Humic acid also plays a role in raising the internal concentration of hormones, especially GA3 and IAA, by stimulating the synthesis of these hormones or preventing their catabolism, which leads to an increase in secondary metabolic compounds, including volatile oils[2] . Humic acid also leads to an increase in the percentage of oxygen compounds (Solid) in the oil, increasing which ultimately leads to an increase in the value of the specific gravity of the volatile oil, and thus an increase in its density and refractive index [4]

References:

1. Ahmed, I., K., Ziaf, M., Qasim and M., Tariq. (2007) . comparative evaluation of different Pinching approaches on vegetative and reproductive growth of Carnation (Diathus Caryophyllus) institule of Horticulturd . Sciences of Agriculture , Faisalabad-380 ,Pakistaa
2. Alam, M.M., Naeem, M. ; Idrees, M. ; Masroor, M. ; Khan , A. and Moinuddin. 2012.Augmentation of Photosynthesis ,Crop Productivity, Enzyme Activities and Alkaloids Production in Sadabahar (Catharanthus Roseus L.) Through Application of Diverse Plant Growth Regulators . Journal of Agronomy and Crop Science, Biotech . 15 (2):117- 129
3. Al-Halabi, Haneen Essam Saleh. 2012. The effect of cytokinin and NPK compound fertilizer on the growth and active compounds of the black cumin plant, Nigella Sativa L.. Master's thesis, Ibn al-Haytham College of Education, University of Baghdad, Iraq.
4. Amin, Mazen Musa Abdel and Jamal Ahmed Abbas. (2019). The effect of biofertilizer, spraying with humus, and fertilizing with magnesium on the quantitative and qualitative characteristics of the volatile oil in the mint plant.
5. EL-Akabawy, M.A.(2000). Effect of some bio fertilizers and farmyard manure on yield and nutrient uptake of Egyptian clover grown on loamy sand

ISSN 2072-3857

soil. Egyptian Journal of Agricultural Research.78(5): 1811-1820

6. El-Lethy , S , R .; Ayad ,H .S . and Reda , F .(2011). Effect of riboflavin , ascorbic acid and dry yeast on vegetative growth , essential oil pattern and antioxidant activity of geranium Pelargonium graveolens L. American
7. Ezz El-Din A . A . and Hendawy , S . F .(2010) . Effect of dry yeast and compost tea on growth and oil content of Baragoofficinalis Plant . Research journal of agriculture and Biological Sciences 6(4).424-430.
8. Guenther,E.1972. the essential oils .Vol. IV. Van Nostrand Co.,Inc.Newyork.P.5:563-570.
9. Habib ullah.R.Y.K.,2012. Fruit yield and Quality Anise (Pimpinella anisum) in Relation to Agronomic and Environmental Factors ,A thesis submitted for the requirement of the Doctoral Degree in Agriculture from the Faculty of Agricultural Sciences , Nutritional Sciences ,and Environmental Management , Justus Liebig University Giessen
10. Jalayerinia,N.; Kalat, S. M. N. and Haghighi, R. S. (2017). The effect of vermicompost and spraying with humic acid and fertilizer on quantitative and qualitative characteristics of rosemary. Asian Journal of Biological and Life sciences.6(1):342-346
11. Mousavi, M.; soleyman A. and shams, M. (2012). changes in yield and yield components of three cultivar , of barley under different nitrogen levels in Isfahan region . International Journal of Agricultural and Crops Sciences. 4(19): 1433-1435
12. Peter, K. V., (2004). Hand Book of Herbs and Spices. CPC press LIC, North and South America. Pp 215-224.
13. Pettit, R.E. (2008). Organic Matter, Humus, Humate, Humic Acid, Fulvic Acid and Humin: Their Importance in Soil Fertility and Plant Health. [Online]. Corpus ID: 15995040..
14. Rao K. U., R. C. Sekhar, J. D. Babu and M. R. Kumar.(2008). Effect of pinching at different days after planting on flowering behavior in three cultivars of carnation (Dianthus caryophyllus Linn). J. Res. Angrau. 36(1):30 – 35
15. Sarhiad, M.M. (2012). Effect of Organic fertilization and Foliar Application of KELPAK and ULTRAKEL on growth and Active Compound of Apium gravolens . Master massage. Collage of Agriculture. Tikrit University.
16. Shoukat, H. S. (2007). Influence of combined application of nitrogen and

ISSN 2072-3857

kinetin on nutrient uptake and productivity of Black Cumin Nigella sativa L. Asian J. Plant Sci., 6 (2):403-406

17. Wareing, P. E. and I. D. J. Phillips. (1981). Growth and differentiations in plants fergamon. Press, oxford

18. Youssif, A. A. and M. T. Iman (1998). Physiological effect of brassinosteroid and kinetin on the growth and chemical constituents of Lavandula officinallis L. plant. Annals. Agric. Sci. Ain. Shams. Univ. Cairo., 43 (1): 261

ISSN 2072-3857