Study of the physical and chemical properties of the essential oil in basil plants under the influence of spraying with naphthalene acetic acid and glycine.

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Abstract

A field experiment was conducted during the summer season of 2024 at the Agricultural Research Station affiliated with the College of Agriculture, Anbar University (Al-Baitha), located at longitude 33.4538 east and latitude 43.3270 north. The experiment employed a split-plot design conducted as a randomized complete block design (RCBD) with three replicates.. The main plots were occupied by four concentrations of naphthalene acetic acid (NAA) (0, 50, 100, 150) ml L-1, and sub plots were occupied by four concentrations of glycine (0, 500, 1000, 1500) mg L-1. The results showed that Naphthalene acetic acid (NAA) sprayed at a concentration of 150 ml L-1 increased oil percentage, specific gravity, refractive index, and the active compound eugenol, while 100 ml L-1 NAA gave the best concentration of linalool. Glycine, at a concentration of 1500 mg L-1, provided the maximum increase in the aforementioned properties. It can be concluded that spraying naphthalene acetic acid and glycine on aromatic basil plants improved the properties and quality of the volatile oil in basil leaves.

Introduction

Basil basilicum ocimum L. is a summer herbaceous plant belonging to the Lamiaceae family, which combines numerous medicinal, culinary, and aromatic uses[1,8] . Basil is native to northeast Africa, northwest India, and central Asia[2] . Basil leaves and seeds contain volatile oils ranging from 0.1 to 0.45%, which are characterized by their volatile aromatic properties, as they contain medically active compounds such as eugenol, linalool, and methylcafecol [7]. Due to the presence of active compounds, basil oil has many industrial uses, such as cosmetics, perfumes, and fragrances, and in medical biotherapy, such as indigestion, nausea, and fever. It is also used for food, either fresh or in the form of spices, and in the manufacture of vinegar and sweets[6,11] . In addition to its oil containing flavonoids, saponins, and phenols, the plant also contains many biological activities and antioxidants and includes many aromatic compounds [5]. These compounds can be affected by any chemical additives, causing an imbalance in their chemical composition, which makes adding nutrients in the form of chemical fertilizers slow. Decomposition and transport within the plant due to contamination of these compounds and change their chemical composition, therefore alternatives must be used that help provide the plant with nutrients and do not affect the chemical structure of their compounds, such as plant growth regulators and amino acids. Naphthalene acetic acid is one of the synthetic plant growth regulators from the auxin family, which has an important role in the physiological processes of the plant and improves the characteristics of vegetative growth through active cell division and cell elongation, which leads to an increase in the ability to photosynthesize and thus improve vegetative growth. It can also enhance the effective division of accumulations from the source and the drain in crop plants [9.[

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Glycine is an amino acid widely found in many plants and is an essential source of nitrogen due to its small size. It plays a role in activating carbon metabolism and increasing its efficiency by stimulating chlorophyll and vegetative growth. It also plays a role in chelating some nutrients [4]. Glycine plays a role in nutritional management in many plant species, as its addition has a beneficial effect on improving the quality and productivity of leafy vegetable crops [10].Based on the importance of what was mentioned and the scarcity of pharmaceutical and agricultural research and studies on the Basil plant and the effect of naphthalene acetic acid and glycine on the plant's vegetative growth, increased leaf yield, and its impact on seed yield, this experiment was conducted to study the physical and chemical properties of the volatile oil in Basil plants under the influence of spraying with naphthalene acetic acid and glycine and the interaction between them.

Materials and Methods

A field experiment was conducted during the summer season in early July 2024 at the Agricultural Research Station of the College of Agriculture, University of Anbar, to study the physical and chemical properties of the volatile oil in Basil plants under the influence of spraying with naphthalene acetic acid and glycine. The experiment was implemented using a randomized complete block design (RCBD) and a split plot design with three replicates. The main plots were allocated to the foliar spray treatment with naphthalene acetic acid, which included four concentrations (0, 50, 100, and 150 ml L-1), and the secondary plots were allocated to the acid Glycine included four concentrations (0, 500, 1000, 1500 mg L-1). The land was plowed in two perpendicular lines and then divided into an experimental unit with dimensions of (2 x 2) m, so that the area of the experimental unit became 4 m2. Each experimental unit contains four lines, so the total number of experimental units is (48), each experimental unit contains four lines. The plants were sprayed in the early morning with naphthalene acetic acid at (the beginning of flowering) on the plant leaves until the plant was completely wetted using a 15-liter backpack sprayer. A spreading material was added, while Glycine was sprayed four days after spraying naphthalene acetic acid. A drip irrigation system was used, and weeding operations were carried out whenever necessary.

Studies traits

The essential oil was extracted by hydrodistillation using a Glevenger apparatus. The following properties of the essential oil were studied:

.1Percentage of essential oil(%)

.2Refractive index of essential oil

.3Density of essential oil (mg/µL(

.4Estimation of active compounds in essential oil

The analyses were conducted in the laboratories of the Scientific Research Authority / Environment and Water Research Center using a GC 280 gas chromatography device. The compounds were identified (Eugenol %), Linalool.(%

Statistical Analysis:

The data were analyzed statistically using the Genstat program, and the averages were compared according to the D.S.L (Least Significant Difference) test at a probability level of 0.05 [3.[

Results and Discussion

.1Percentage of essential oil(%)

The results of Table (1) indicate that spraying Naphthalene acetic acid led to a significant

increase in the percentage of volatile oil, which reached 1.756% at the high concentration of naphthalene acetic acid (150 ml L-1), then decreased in the control treatment to the lowest oil percentage of 0.453%. Spraying with glycine at a concentration of 1500 mg L-1 led to a significant increase in the oil percentage of 1.204%, while the lowest value was given in the control treatment of 0.913%. Regarding the interaction, Table (1) shows that the interaction of spraying naphthalene acetic acid and glycine showed significant effects on this trait, as plants sprayed with a concentration of 150 ml L-1 of naphthalene acetic acid and a concentration of 1500 mg L-1 of glycine gave the highest oil percentage of 1.955% compared to the no-spray treatment

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Table (1) Effect of naphthalene Acetic acid, glycine, and their interaction in the percentage of volatile oil in leaves

Average Naphthalene Acetic Acid (ml/L-1)(	Glycine acid (mg L-1)				Naphthalene acetic acid ml.L-1
	(1500)	(1000)	(500)	(0)	
0.453	0.566	0.516	0.378	0.350	(0)
1.176	1.358	1.218	1.107	1.022	(50)
0.822	0.936	0.874	0.748	0.728	(100)
1.756	1.955	1.802	1.714	1.551	(150)
	1.204	1.102	0.987	0.913	Average glycine (mg L-1)(
interaction	glycine		naphthalene		L .S .D 0.05
0.10480	0.03447		0.09577		

-2Specific gravity of essential oil

Table (2) shows a significant difference between the concentrations of naphthalene acetic acid. Plants sprayed with a concentration of 150 ml L-1 recorded the highest average for the specific gravity of the oil, reaching 0.97975, while the control treatment recorded the lowest average, reaching 0.91325. A significant increase in the specific gravity of the oil was observed under the influence of glycine spraying, as the concentration of 1500 mg L-1 gave the highest average, reaching 0.95292, while the control plants gave the lowest average for this trait, reaching 0.93308. Regarding the interaction between the two study factors, plants sprayed with a concentration of 150 ml L-1 naphthalene acetic acid and a concentration of 1500 mg L-1 glycine achieved the highest average for this trait, reaching 0.99600, compared to the control treatment, which achieved the lowest average, reaching 0.90200.

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Table (2) Effect of spraying with naphthalene acetic acid and glycine and their interaction on the specific gravity of volatile oil

Average Naphthalene Acetic Acid (ml/L-1)(	Glycine acid (mg L-1)				Naphthalene acetic acid ml.L-1
	(1500)	(1000)	(500)	(0)	
0.91325	0.92000	0.91700	0.91400	0.90200	(0)
0.93042	0.93767	0.93200	0.92800	0.92400	(50)
0.95008	0.95800	0.95300	0.94633	0.94300	(100)
0.97975	0.99600	0.98733	0.97233	0.96333	(150)
	0.95292	0.94733	0.94017	0.93308	Average glycine (mg L-1)(
interaction	glycine		naphthalene		L .S .D 0.05
0.002540	0.001371		0.001150		

-3Refractive Index of Essential Oil

Table (3) indicates that naphthalene acetic acid concentrations had a significant effect on the refractive index of essential oil, with the concentration (150) ml L-1 yielding the highest mean of 2.027, while the concentration (50) ml L-1 yield the lowest mean of 1.288. The results of the same table also showed that glycine concentrations had a significant effect on the refractive index, with the concentration (1500) mg L-1 yielding the highest mean of 1.6776, while the control treatment yielded the lowest mean of 1.5203. The interaction between the two study factors had a significant effect on this trait, as plants sprayed with concentrations of (150) ml L-1 of naphthalene acetic acid and (1500) mg L-1 of glycine acid gave the highest interaction rate, reaching 2.1033 points, while the control treatment gave the lowest interaction rate, reaching 1.2603 points.

Table (3) Effect of spraying with naphthalene acetic acid and glycine and the interaction between them on t
he refractive index of volatile oi

Average Naphthalene Acetic Acid (ml/L-1)(	Glycine acid (mg L-1)				Naphthalene acetic acid ml.L-1
	(1500)	(1000)	(500)	(0)	
1.399	1.4853	1.3950	1.3827	1.3347	(0)
1.288	1.3117	1.2833	1.2953	1.2603	(50)
1.686	1.8100	1.7280	1.6667	1.5400	(100)
2.027	2.1033	2.0537	2.0037	1.9463	(150)
	1.6776	1.6150	1.5871	1.5203	Average glycine (mg L-1)(
interaction	glycine		naphthalene		L .S .D 0.05
0.03508	0.01448		0.02849		

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-4Linalool%

The results of Table (4) confirmed the presence of significant differences in the concentrations of naphthalene acetic acid

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sprays on the concentration of linalool in the leaves of the basil plant. The treatment (100 ml L-1) achieved the highest concentration of 15.97%, while the treatment (without spray) gave the lowest concentration of linalool, reaching 7.25%. When spraying plants with glycine, there was an increase in the concentration of linalool. Plants sprayed with a concentration of 1500 mg L-1 gave the highest concentration of 12.30%, compared to the control treatment (spraying with water only), which gave the lowest concentration of the compound, reaching 9.33%. The same applies to the interaction treatment, as the interaction treatment, spraying with a concentration of 100 ml L-1 with naphthalene acetic acid and the highest concentration of glycine (1500 mg L-1), gave the highest value, reaching 17.36%, compared to the non-spraying treatment (sprayed with water only), which gave the lowest concentration of the compound, reaching 6.33% .

Table (4) Effect of spraying with naphthalene acetic acid and glycine and their interaction on the concentration of linalool compound%

Average Naphthalene Acetic Acid (ml/L-1)(	**Glycine acid (mg L-1)**				**Naphthalene acetic acid ml.L-1**
	(1500)	**(1000)**	**(500)**	**(0)**	
7.25	**7.89**	**7.45**	**7.31**	**6.33**	**(0)**
8.78	**10.23**	**9.44**	**8.32**	**7.14**	**(50)**
15.97	**17.36**	**16.41**	**15.59**	**14.52**	**(100)**
11.81	**13.72**	**13.22**	**10.98**	**9.34**	**(150)**
	12.30	**11.63**	**10.55**	**9.33**	**Average glycine (mg L-1)(**
interaction	glycine		**naphthalene**		**L .S .D 0.05**
0.7629	**0.2626**		**0.6858**		

-5Eugenol%

Table 5 shows that spraying with naphthalene acetic acid and glycine significantly increased the concentration of eugenol. Spraying with naphthalene acetic acid at a concentration of 150 ml L-1 yielded a significant value of 51.65% compared to the control treatment, which yielded the lowest rate of 34.49%. The results of the same table also indicated significant differences between the glycine spray concentrations. The 1500 mg L-1 concentration achieved the highest eugenol concentration of 45.78% compared to the no-spray treatment, which yielded the lowest rate of 41.07%. The results also showed a significant interaction between the concentrations of naphthalene acetic acid and glycine sprays, as plants sprayed with 150 ml L-1 naphthalene acetic acid and 1500 mg L-1 glycine gave the highest concentration rate of 55.38%, while plants sprayed with water only gave the lowest rate of 31.79% .

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Table (5) Effect of spraying with naphthalene acetic acid and glycine and the interaction between them on the concentration of eugenol compound%

Average Naphthalene Acetic Acid (ml/L-1)(	Glycine acid (mg L-1)				Naphthalene acetic acid ml.L-1
	(1500)	(1000)	(500)	(0)	
34.49	37.31	34.96	33.90	31.79	(0)
41.39	43.01	41.54	41.45	39.56	(50)
46.35	47.43	46.82	46.26	44.88	(100)
51.65	55.38	52.71	50.47	48.57	(150)
	45.78	44.01	43.02	41.07	Average glycine (mg L-1)(
interaction	glycine		naphthalene		L .S .D 0.05
1.0599	0.5664		0.5084		

The reason for the increased percentage of volatile oil in basil leaves is attributed to the role of naphthalene acetic acid in increasing nutrient absorption and its role in vital processes occurring within the plant, such as photosynthesis and respiration. This role leads to the production of secondary compounds and chemicals used by the plant to form byproducts of these processes, including the volatile oil. Increasing the percentage of volatile oil led to an increase in the specific gravity of the oil and the refractive index of the volatile oil. This is due to the direct correlation between them, as the specific gravity of the essential oil and the refractive index decrease with decreasing oil content, and vice versa. This is in addition to an increase in active compounds such as linalool and eugenol.

Glycine had a clear effect in increasing the percentage of volatile oil by increasing the absorption of water and nutrients such as nitrogen and increasing chlorophyll content. This was reflected in improving the plant's performance in physiological processes by delaying leaf aging and increasing leaf vitality. This led to an increase in the efficiency of photosynthesis, and consequently, an increase in vegetative growth characteristics. This was reflected in an increase in the formation of primary metabolism and its conversion by important enzymes to secondary metabolism, which increased the percentage of volatile oil. In the leaves, glycine plays a role in resisting biotic and abiotic stresses, which keeps the plant in a state of balance within its components. It is a regulator of many vital and enzymatic processes within the plant. Increasing the volatile oil content increases the specific gravity value, which is directly linked to the refractive index. This increases the specific gravity as a result of glycine's direct or indirect influence, through its interaction with hormones and the creation of new biological pathways that increase the output of primary and secondary metabolism, including active compounds such as linalool and eugenol within the plant leaves .

These results are consistent with the findings of [12] in a study on fenugreek plants, which showed that spraying naphthalene acetic acid increased the total phenol content.

These results are consistent with the findings of [13] which found that spraying naphthalene acetic acid on mustard plants increased the content of oil, saponification, and chemicals such as palmitic, stearic, and erucic acids, as well as fatty acids. These results are consistent

with the findings of El-[14] who reported that spraying coriander with glycine increased the content of essential oils (linalool, camphor, and alpha-pinene). These results are consistent with the findings of [15] in a study on sage, where spraying with glycine increased the percentage of essential oil and its content of active compounds 1,8-cineole, alpha-pinene, and alpha-tahagon.

Conclusions

The response of the aromatic basil plant to spraying with different concentrations of naphthalene acetic acid and glycine was reflected in the positive effect on the physical and chemical properties of the volatile oil and the volatile oil content of active compounds in basil leaves.

Recommendations

Spraying naphthalene acetic acid and glycine at different concentrations and expanding new studies on medicinal plants.

•Focusing on the study of medicinal plants in general, and aromatic basil in particular, and expanding their cultivation in Iraq due to their nutritional, medicinal, and industrial benefits.

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