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Role of Nano Organic Fertilizer in Improving Content of Rocket (*Eruca sativa* Mill) Varieties from Some Secondary Metabolism Compounds

Ali S. HASSOON[1], Ali Ahmed Hussien ALMYALI[2,3], Ahmed A. KADHIM[1] & Jassim Jawad JADER[1]

[1] Almusaib Tech. College, Al-Furat Al-Awaset University, Iraq
[2] Department of Biological Science, College of Sciences, University of Kerbala, Karbala, Iraq
[3] College of Pharmacy, University of Alkafeel, Najaf, Iraq

SUMMARY. **A field experiment was carried out during the agricultural season 2020-2021 in Babil Governorate / Hilla district in one of the vegetable farms to find out the effect of the variety and the Nano-organic fertilizer in Rocket leaves content of some secondary metabolism compounds. A factorial experiment was applied according to Block Complete Randomized Design, and it included two factors, the first three varieties of Rocket (Egyptian, Syrian and local), the second factor is spraying the Nano-organic fertilizer with four concentrations (0, 1, 2, 3 and 4) L ha-1. Some of the active ingredients by High-Performance Liquid Chromatography (HPLC). The results showed the superiority of Egyptian variety on other varieties alone and interaction with the concentration of 3 of organic Nano fertilizer in all studied compounds, and the interaction between them recorded the highest means of euric acid, jaconine, dehydrojcoline and erucifoline, amounting to (459.0, 1006.13, 408.3 and 394.40) ppm respectively, while Syrian variety had recorded lowest means (260.3, 896.10, 315.1 and 318.76) ppm respectively.**

RESUMEN. Se llevó a cabo un experimento de campo durante la temporada agrícola 2020-2021 en la gobernación de Babil / distrito de Hilla en una de las granjas de hortalizas para averiguar el efecto de la variedad y el fertilizante nanoorgánico en el contenido de hojas de rúcula de algunos compuestos del metabolismo secundario. Se aplicó un experimento factorial según Diseño Completamente Aleatorio en Bloques, el cual incluyó dos factores, las tres primeras variedades de Rocket (egipcia, siria y local), el segundo factor es la aspersión del fertilizante Nano-orgánico con cuatro concentraciones (0, 1, 2, 3 y 4) L.ha-1. Algunos de los ingredientes activos por el método cromatográfico de cromatografía líquida de alto rendimiento (HPLC). Los resultados mostraron la superioridad de la variedad egipcia sobre otras variedades solas y la interacción con la concentración de 3 de fertilizante orgánico Nano en todos los compuestos estudiados, y la interacción entre ellos registró las medias más altas de ácido eurico, jaconina, dehidrojcolina y erucifolina, que ascienden a (459.0, 1006.13, 408.3 y 394.40) ppm respectivamente, mientras que la variedad Siria registró las medias más bajas (260.3, 896.10, 315.1 y 318.76) ppm, respectivamente.

INTRODUCTION

Medicinal plants have a prominent position in many fields, including therapeutic, complementary, preventive and nutritional medicine, weight loss programs, pharmaceutical and food industries, and biological control because they contain many active compounds [1] produced by the plant from secondary metabolism to accomplish many biological functions as they act as defensive chemical weapons Against carnivorous and plant-pathogenic pests, attracting insects to complete pollination and balancing the slimy system to withstand some environmental stress conditions [2] or may be produced to inhibit or encourage growth, a method of food storage, or the disposal of some toxic substances [3]. Rocket (Eruca sativa Mill.) is one of the annual herbal plants of medicinal and nutritional importance, belongs to Brassicaceae family [4], and its cultivation is spread in temperate regions All year round, except for the very hot and cold months [5]. The plant kingdom produces a wide range of secondary metabolism compounds estimated at more than 88000 compounds, most of which are compounds produced by medicinal plants as a result of their influence by genetic and environmental factors, as the outcome of these two factors determines the quantitative and qualitative characteristics of these compounds [6]. In Rocket plant, this discrepancy is evident among its varieties spread in the temperate region of the world in the quantity and quality of its active compounds and the

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* Author to whom correspondence should be addressed. *E-mail:* com.hs.ali@atu.edu.iq

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yield of its leaves and oil, due to the presence of several sources of genetic variation for this plant, including cases of self-incompatibility between plants of some varieties, sib-mating and diversity of pollination means Close inbreeding, polyploidy, and heterogeneity of the environmental factor [7,8]. Nanotechnology provides a wide scope for new uses in the fields of biotechnology, agriculture and the fertilizer industry Since nanomaterial's possess unique physical and chemical properties due to their high surface area, it is possible to turn to alternative natural sources for the manufacture of Nano-fertilizers in order to reduce environmental pollution and provide human safety and health as well as reduce the economic costs that arise from the use of chemical fertilizers [9]. Also, nano-fertilizers are more efficient than conventional fertilizers as they enhance the efficiency of the use of nutrients and reduce fertilizer losses as they regulate the release of nutrients according to the requirements of the crops [10]. Based on the foregoing, this study aimed to find out the effect of the variety and the nano-organic fertilizer in Rocket leaves content of some medically effective metabolism.

MATERIAL AND METHODS

A field experiment was carried out during the agricultural season 2020-2021 in Babil Governorate / Hilla district in one of the vegetable farms. Nine random samples were taken from the field soil before planting for both seasons of the experiment at different depths of 0-60 cm. Then the samples were mixed homogeneously and exposed to sunlight. For 24 h, it was ground and sieved with a sieve with holes of 2 mm, after which some chemical and physical properties of the soil were estimated in the research laboratory of the College of Agriculture / University of Baghdad. **Table 1** shows the results of analyzes of field soil.

Character	pH	Ec	N	O.M	Soil Separators			Soil texture
					Sand	Loam	Clay	
Unit	-	ds m-1	g.kg-1	g.kg-1	g.kg-1	g.kg-1	g.kg-1	---
Value	7.8	2.6	92	19.5	238	394	359	clay loam

Table 1. Physical and Chemical properties of Field Soil.

The field soil was prepared for planting seeds after immersion irrigation, then the soil was plowed by two orthogonal plows, during which the decomposed organic fertilizer was added at an amount of 10 m3 d, then the soil was smoothed and leveled, then the field was divided into boards 5 m long and three meters wide, leaving a distance of half a meter between one slab and another. A service corridor is counted every 12 replicate, so the number of experimental units is 48 experimental units, each of which has an area of 12 m^2. The seeds were sown in the field directly on the date of 2 and 15/10, within lines in the experimental unit, with a distance of 25 cm between one line and another and 10 cm between one hole and another. All service according to the recommended and the needs of the plants [11]. A factorial experiment was applied according to Block Complete Randomized Design, and it included two factors, the first three varieties of Rocket (Egyptian, Syrian and local), the second factor is spraying the Nano-organic fertilizer with four concentrations (0, 1, 2, 3 and 4) L.ha- 1 was added in three stage. Table 2 shows the most important organic compounds found in the Nano-organic fertilizer.

Content	W/W	W/V
Organic (Seaweed)	5.4	6.5
N	7	8.7
Alganic acid	1.6	2
Micro element (Cu+Zn+Fe+B+Mo)	0.35	0.44
Amino acids	0.15	0.19
Beatin	0.01	0.012

Table 2. Organic ingredients in nano-organic fertilizer (biozar nano fertilizer) produced by Fanavar Nano-Pazhoohesh Markazi Company, Iran.

High Performance Liquid Chromatography (HPLC) was used to determine the concentration of active compounds in leaves of Rocket plant, and HPLC device of modern type (Kyoto Japan Shimadzu model) was used to determine retention time and area of sample package for both standard solution and sample solution. Column C-18 (I.d mm) was used. 4.6×50) and the mobile phase was pushed at a flow rate of 1.4 ml/min. The readings were measured at a wavelength of 330 nm at a temperature of 30 °C. The sample solution was prepared by taking 1g of ground samples of leaves seeds [12,13].

The concentration of the compounds in the model was calculated according to the following equation: *Concentration of sample = Area f sample/ Area of standard*

Seq	Subject	Retention time	Area	Concentration (ppm)
1	Euric acid	2.6	18571	25
2	Jaconine	4.55	189176	25
3	Dehydrojcoline	6.27	227016	25
4	Erucifoline	7.17	198137	25

Table 3. Retention time and area for some measured active compounds.

The results were statistically analyzed using the Genstat program and the means were compared on the basis of the least significant difference (L.S.D) test at a 5% probability level [14].

RESULTS

The results of **Table 4** and the analysis of variance in Table 8 indicate that there are significant differences between the Rocket varieties in their Euric acid content, as the Egyptian variety achieved the highest mean of (423.0) ppm, while the Syrian variety recorded the lowest mean (388.1) ppm. The concentrations of the Nano-organic fertilization differed significantly mselves, as the spraying with concentration (3) L.ha - 1 recorded the highest mean for the content of Rocket leaves, the highest mean (428.0) ppm, significantly superior to the control treatment that recorded the lowest mean of (347.7) ppm. The interaction between the variety and the organic Nano fertilization had a significant effect in content of Euric acid (ppm) in leaves. The highest mean reached (459.0) ppm, while the interference (the Syrian + Control variety) recorded the lowest mean amounted to (260.3) ppm.

Variety / Fertilizer L. ha- 1	Syrian	Egyptian	local	Means
0	260.3	407.7	375	347.7
1	308.7	392.7	356.8	352.6
2	393.3	432.7	400.7	375.7
3	402.7	459	422.3	428
Means	292.2	423	388.1	
L.S.D(0.05)	Variety	Fertilizer	Variety* Fertilizer	
	13.92	16.07	29.84	

Table 4. Effect of variety and nano organic fertilizer in the content of Rocket leaves from euric acid (ppm).

It is noticed from the results of **Table 5** and analysis of variance in **Table 8** that there are significant differences between the Rocket varieties in their Jaconine content, as the Egyptian variety recorded the highest mean of (979.51) ppm, while the Syrian variety gave the lowest mean (928.84) ppm. The addition of different concentrations of organic Nano-fertilization achieved a significant increase, as the spraying with concentration 3 L ha-1 recorded the highest mean for the content of leaves from Rocket, the highest mean (924.57) ppm, significantly superior to the control treatment that recorded the lowest mean of (347.7 ppm. The effect of the interaction between variety and organic Nano-fertilization significantly in the leaves content of E Jaconine (ppm), as the interaction achieved (the Egyptian cultivar + spraying with concentration (3) l ha-1. The highest mean reached (1006.13) ppm, while interaction (Syrian + Control variety) achieved the lowest mean reached (896.10) ppm.

Variety /Fertilizer L.ha- 1	Syrian	Egyptian	local	Means
0	896.1	952.8	924.82	924.57
1	919.5	966.63	936.47	940.87
2	941.5	992.47	964.77	966.24
3	958.27	1006.13	986.27	983.56
Means	928.84	979.51	953.08	
L.S.D(0.05)	Variety	Fertilizer	Variety* Fertilizer	
	2.933	3.386	6.265	

Table 5. Effect of variety and nano organic fertilizer in the content of Rocket leaves from jaconine (ppm).

The results of the statistical analysis **Table 6** and the analysis of variance **Table 8** indicate that there are significant differences between the Rocket varieties in the content of their leaves from Dehydrojcoline, as the Egyptian variety achieved highest mean of (355.9) ppm, superior to the Syrian variety, which recorded the lowest mean (328.6) ppm. The Nano-organic fertilizer spraying caused a significant difference, as the spraying with concentration (3) l ha-1 recorded highest mean for the content of leaves from Rocket, highest mean (363.4) ppm compared to non-spray treatment which recorded lowest mean of (343.2) ppm. The interaction between variety and the organic nano-fertilization showed a significant effect on the leaf content of dehydrojcoline (ppm), as the interaction treatment (Egyptian variety + spraying with concentration (3) l ha-1achieved highest mean of (408.3) ppm, while the interaction treatment (Syrian variety) +Control) lowest mean of (315.1) ppm.

Variety /Fertilizer L.ha- 1	Syrian	Egyptian	local	Means
0	315.1	338.2	324.9	343.2
1	336.2	354.1	342.1	355
2	356.9	370.4	360.5	356
3	384.8	408.3	361.3	363.4
Means	328.6	355.9	378.7	
L.S.D(0.05)	Variety	Fertilizer	Variety* Fertilizer	
	3.16	5.19	9.31	

Table 6. Effect of variety and nano organic fertilizer in the content of Rocket leaves from dehydrojcoline (ppm).

The results of **Table 7** and analysis of variance in **Table 8** show that there are significant differences between Rocket varieties in their content of Erucifoline, as the Egyptian variety recorded the highest mean of (360.08) ppm, while the Syrian variety gave the lowest mean (333.82) ppm. The addition of different concentrations of organic nano-fertilization achieved a significant increase, as the spraying with concentration 3 L.ha-1 recorded the highest mean for the content of leaves from Rocket, highest mean (370.00) ppm, significantly superior to the control treatment that recorded the lowest mean of (327.53) ppm. The effect of the interaction between variety and the organic Nano-fertilization significantly on the leaves content of Erucifoline (ppm), as the interaction achieved (Egyptian + variety spraying with concentration (3 L.ha-1) highest mean was (394.40) ppm, while the interference (the Syrian + Control variety) achieved lowest mean, which was (318.76) ppm.

Variety /Fertilizer L.ha- 1	Syrian	Egyptian	local	Means
0	318.76	338.3	325.53	327.53
1	327.6	344.9	335.27	335.92
2	340.67	362.73	344.73	349.38
3	348.23	394.4	367.37	370
Means	333.82	360.08	343.23	
L.S.D(0.05)	Variety	Fertilizer	Variety* Fertilizer	
	3.897	4.375	8.749	

Table 7. Effect of variety and nano organic fertilizer in the content of Rocket leaves from erucifoline (ppm)

S.O.V	.f	Euric acid	Jaconine	Dehydroj-coline	Erucifo-line
Replication	2	306.8	35.71	454.3	96.88
Fertilizer	3	4464.4*	6185.37*	5699.9*	3089.07*
Variety	2	55150.1*	7706.14*	1606.8*	2125.43*
Variety* Fertilizer	6	1028.1*	34.32*	283.3*	141.04*
Residual	22	270.3	12	241.5	15.89

Table 8. Analysis of Variance represented by Means of Squares (MS) for studied traits.

DISCUSSION

The reason for the difference between Rocket varieties in their content of some secondary metabolism may be due to the genetic ability of the variety to express itself in its cultivation environment as the difference in soil conditions (Table 1) and this is agreed with what was found [15-17]. The increase in the content of Rocket leaves from secondary metabolic compounds as a result of spraying the organic Nano-fertilizer to its role in many biological and physiological processes that occurred in the plant in addition to the production of amino acids and enzymes that lead to an increase in cell divisions and thus increase the starch of antioxidant enzymes and this is reflected positively on the increase in the content of leaves secondary metabolites [18,19], these results agree with what you get [20-23].

CONCLUSION

In light of the obtained results, it can be concluded that spraying the Nano-organic fertilizer increased the content of Rocket varieties of the studied secondary metabolites, especially the Egyptian variety.

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