

Effect of moringa leaf extract, Kinetin and humic acid on the growth and yield of Rocket plant

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Abstract

This experiment was conducted in an orchard in Babylon province - Al-Kifl district, in autumn season of the year 2021-2022, on the Rocket plant (*Eruca vesicaria* subsp. *sativa*). To know the effect of the first factor, Moringa extract at concentrations of 10 g/L, 20 g/L, and Kinetin at concentrations of 20 mg/L, 40 mg/L, and the second factor, humic acid at concentrations of 2 kg/ha, 4 kg/ha, with the control treatment (without addition or spraying) for each factor and the interaction between factor on the growth yield of Rocket. It was conducted as a factorial experiment (5x3x3) according to the Complete Randomized Blocks Design (R.C.B.D) and with three replicates, where each replicate contains 15 treatments. The results showed that there are significant differences in the vegetative traits of Moringa extract, chitin and humic acid. The results indicate that the treatment of Moringa leaf extract with a concentration of 10 g / L was excelled in giving the highest plant height (57.95 cm), the highest number of leaves (19.09), and the highest percentage of dry matter for the first cutting (6.040 %). The results also indicate that the treatment of Kinetin with a concentration of 20 mg / L was excelled in giving the highest dry weight for the first cutting which reached (5.437 %) and the highest dry weight for the second cutting was (5.923 %). (2.252 tons) and the highest yield for the second cutting was 1.737 tons. The results also indicate the humic acid treatment at a concentration of 4 kg / ha excelled by giving the highest plant height (58.87 cm), the highest percentage of dry matter for the second for cutting (7.083 kg), and the highest yield for the second cutting 1.464 tons/ha (Likewise, the humic acid treatment excelled at a concentration of 2 kg / ha by giving the highest yield for the first cutting, which reached (1.926 tons), and the control treatment excelled in the number of leaves, recording the highest mean of 18.34. As the signals of the results in the interaction in trait of plant height. The treatment, M2H2, recorded the highest average of (70.25 cm). As for the number of leaves, it was recorded as M1H0, and the highest average was 25.80. In trait of the percentage of dry matter for cutting first, the treatment M2H2 recorded the highest average of (6.88) kg. As for the percentage of dry matter for cutting the second, the treatment M3H2 recorded the highest average (7.525 kg). As for the yield of the first for cutting, the treatment M4H2 recorded the highest average (2.580 ton/ha). As for the yield of the second for cutting, the treatment M2H1 recorded the highest average (2.093 %)

Keywords: Moringa extract, humic acid, kinetin, Rocket plant introduction:-

introduction

Medicinal plants are a huge storehouse of natural products, which are classified into primary metabolism products and are essential for plant nutrition such as carbohydrates, proteins and fats. and secondary metabolic products such as the active ingredients in plants, which are produced from primary metabolism products and used by the plant as

defense materials and to protect itself from any external damage and stress. It also enables him to adapt to his environment. By-products of metabolism have importance in promoting human health through the use of these products as antioxidants or antibacterials (1) Rocket *Eruca vesicaria* subsp. *sativa* is a plant of medicinal and nutritional importance.

It is a winter annual herbaceous plant belonging to the Brassicaceae family. Its cultivation is widespread in temperate regions (2). It is throughout the year, with the exception of the very hot and cold months. It is a plant with simple or lyre-pinnate leaves, white or yellow flowers with violet veins, and its stems are composed of basic branches with secondary branches. It is cultivated in the Mediterranean countries, Egypt, the Levant, Saudi Arabia, India, China and Iran (3). The Rocket plant is used as an appetizer, anti-drilling, to strengthen the gums and prevent bleeding, as a laxative, helps in bile production, accelerates digestion, and cleans the stomach and intestines. Drinking Rocket leaf juice and eating its pungent seeds enhances sex drive, and this may be due to the presence of vitamin H (4). To evaluate the antibacterial effect of aqueous and ethanolic extracts of Moringa leaves (*Moringa oleifera*) on the growth of Gram-positive and Gram-negative bacteria. The study indicates promising potential of aqueous and ethanolic Moringa leaf extracts as an alternative treatment for infections caused by the tested strains. (5) In a study the aim of which was to determine the effect of Moringa leaf extract (MLE) on the growth and yield traits of pepper. The results indicated that there were significant differences between the concentrations of MLE with regard to its effect on the growth and yield of pepper, such as stem circumference, plant length, number of leaves, and fruit yield. Cytokinins are considered to have an essential role in stimulating the process of cell division and their specialization in association with auxins, and their importance is also highlighted in many other physiological processes such as the phenomenon of apical dominance that affects the branching process in plants. The plant is rather one of the products of thermal rotting of adenine. The discovery of kinetin prompted the industrial synthesis of hundreds of compounds similar to it, but kinetin is one of the most common materials used in studies of the physiological effects of cytokinins

(7). In a study the aim of which was to know the effect of different levels of potassium in increasing the concentrations of kinetin on some phenotypic indicators and some indicators of effective medicinal compounds in the local coriander plant (*Coriandrum sativum* L.), a study of some phenotypic growth indicators (plant height, wet weight and dry weight) and compounds Physiological and effective medicinal (8). Humic acid is one of the main products of the decomposition of organic matter (humus) and affects plant growth through the processes of respiration and carbon construction. It activates the enzymes Cytochromease, Oxidase, Phosphatase, Phosphorylase and works to inhibit other enzymes such as IAA oxidase and Peroxidase Fitase (9). In a study of the effect of humic acid on the summer squash plant irrigated with saline water after adding it to the plant twice by spraying and adding it to the soil, the results showed the effect of humic acid in a significant increase in yield and in reducing the percentage of salts in the water (10). The study aims: - To study a comparison between Moringa extract and the compound kinetin and to know their effect on the growth and yield of Rocket plant and a study of the effect of humic acid in interaction with the factors of the previous experiment on the Rocket plant

Materials and Methods

The experiment was conducted in one of the orchards belonging to Al-Kifl district - Babylon province during the autumn season for the year 2021-2022. The factorial experiment (5×3×3) according to the Complete Randomized Blocks Design (R.C.B.D) and with three replicates, where each replicate contains 15 treatments. Treatment The experiment included 45 experimental units. The averages were compared using the Least Significant Difference L.S.D test at the 5% level. (11).

The experiment was analyzed using Genstat software

Treatments included

The first factor: - Spraying the extract of Moringa and Kinetin leaves

- 1- The control treatment, concentration 0, without spraying, and is symbolized by the symbol M0
- 2- Spraying with Moringa leaves extract at a concentration of 10 g/L, and it is symbolized by the symbol M1
- 3- Spraying with Moringa leaf extract at a concentration of 20 g/L and symbolized by M2.
- 4- Spraying with kinetin at a concentration of 20 mg/L and symbolized by the symbol M3
- 5- Spraying with kinetin at a concentration of 40 mg/L, and it is symbolized by the symbol M4

The plants were sprayed with two sprays, the first after the appearance of four true leaves, and the second spray, one month after the first spray

The second factor: - adding humic acid to the soil

- 1- control treatment 0 without addition and is symbolized by the symbol H0
- 2- Adding humic acid at a concentration of 2 kg/ha and denoted by the symbol H1
- 3- Adding humic at a concentration of 4 kg / ha, and it is symbolized by the symbol H2.

The process of adding humic acid to the ground takes place in two stages, the first after a month of cultivation and the second after a

month of the first cutting. Rocket seeds (Egyptian cultivar) were sown in the autumn season in the form of lines inside plots, at a rate of 5 lines for each experimental unit, the distance between one line and another is 50 cm, and between one plant and another is 15 cm). The different service process of irrigation and weeding was conducted throughout the duration of the experiment. The seeds that were prepared from the Agricultural Office, an Egyptian cultivar of origin, were planted on 1/12/2020, at a seeding rate of 9.5 kg / ha (12). It took 7-10 days for the seeds to germinate after planting. The first cutting was dated 2/25/2022, while the second cutting was dated 3/21/2022. Moringa leaf extract was prepared, where young Moringa leaves weighing about 100 g were taken in a container with a little water (10 ml / 100 g fresh material) and ground with a pestle. The juice was extracted by manual pressure and filtered through a soft cloth, and the solution was re-filtered. By using filter paper following the method developed by (13).The extract is diluted with distilled water at a ratio of 1:32 (volume / volume) and then sprayed directly on the Rocket plant. The extract is used after five hours of the extraction process. The prepared extract is stored at a temperature of 0 degrees Celsius and is not taken out when needed for use. The vegetative growth traits of 5 randomly selected plants were taken from the center of the planting lines in the flowering stage of each treatment and for the three replicates, and then the average was taken for the following traits:

Plant height (cm): - The plant height was measured from the point of contact of the main stem with the soil to the top of the growing top of the plant using a measuring tape at the end of the growing season before the date of the last cutting.

Number of total leaves (leaf.plant⁻¹): - The leaves of five plants on the main stem, main branches and side branches taken at random were counted.

Percentage of dry matter of the vegetative total (%):- The percentage of dry matter of the vegetative total was calculated by taking 100 g fresh weight and placed in perforated paper conditions and air dried inside the room. The percentage of dry matter was extracted according to the following equation:

$$100 \times \left(\frac{\text{g of the dry sample weight}}{\text{g of the fresh sample weight}} \right) = (\%) \text{ dry weight of the material percentage}$$

Plant yield in hectares (tons): The yield is calculated by calculating the weight of leaves in all plants of the experimental unit with an area of 6 m² and according to the following equation:

$$\text{Total Yield (kg/ha)} = \text{yield (kg experiment unit-1)} * (10000/6)$$

Table 1. experimental soil characteristic

Valuable	adjective
7.11	pH
3.0	Electrical conductivity (E C) Deci Siemens/m
2.723	Ready nitrogen (mg. 1 kg-1)
9.52	Ready phosphorus (mg. 1kg-1)
31.7	Ready potassium (mg. 1 kg-1)
Soil Separaters	
177	Sand (g. kg-1 soil)
343	Clay clay (g. kg-1 soil)
480	GreenSilt (g. kg-1 soil)
clay mixture	Soil texture (g. kg-1 soil)

Results and discussion

Effect of spraying treatments on vegetative growth traits:

1- Plant height (cm):

The results in Table (1) that spraying treatments with Moringa extract, Kinetin and humic acid and the interaction between the two factors achieved significant differences in plant height. The results showed that spray treatments with Moringa extract and Kinetin. They differed significantly among themselves.

In the first factor, 1M recorded the highest average of 57.95 cm, and M0 recorded the lowest average of 41.43 cm. As for the second factor, humic acid, H2 recorded the highest average of 58.87 cm, and H0 the lowest

average of 43.35 cm. As for the interaction, M2H2 recorded the highest average of 70.25 cm, and M0H0 recorded the lowest average of 28.90 cm.

Table (1) The effect of Moringa leaf extract, Kinetin and humic acid and the interaction between them on the plant height of Rocket for the autumn season 2021-2022

Moringa extract average	humic acid (H)			Moringa leaf extract g/ L (M)
	H ₂	H ₁	H ₀	
41.43	49.40	46.00	28.90	M ₀
57.95	61.20	54.80	57.85	M ₁
57.81	70.25	53.10	50.07	M ₂
46.78	47.40	49.07	43.87	M ₃
49.98	66.10	47.80	36.05	M ₄
	58.87	50.15	43.35	humic acid average
M*H	H		M	LSD 0.05
7.070	3.162		4.082	

2- Number of leaves:

The results in Table (2) that the spraying treatments with Moringa extract, Kinetin and humic acid and the interaction between the two factors achieved significant differences in

in Table (2) that the spraying treatments with Moringa and Kinetin extracts differed significantly among them in trait of the number of leaves. As for the second factor, humic acid, H0 recorded the highest average of 18.34, and the H1 treatment recorded the lowest average of 14.80. As for the interaction, M1H0 recorded the highest average of 25.80, and M0H1 recorded the lowest average. 11.80

traits of the number of the treatment M1 gave highest value (19.09 leaf) while M3 gave lowest value (14.46 leaf). The results showed

Table (2) The effect of Moringa leaf extract, Kinetin and humic acid and the interaction between them on the number of leaves of Rocket plant for autumn season 2021-2022

Moringa extract (M)	humic acid (H)			Moringa leaf extract average
	H ₂	H ₁	H ₀	
17.51	18.13	11.80	22.60	M ₀
19.09	14.87	16.60	25.80	M ₁
14.86	15.07	16.00	13.50	M ₂
14.46	15.00	15.27	13.10	M ₃
15.59	15.73	14.33	16.70	M ₄
	15.76	14.80	18.34	humic acid average
M*H	H		M	LSD 0.05
	4.672		2.089	
	2.697			

3-The percentage of the first cutting dry matter (kg):

It is noted from the results in Table (3) that the spraying treatments with Moringa extract, kinetin and humic acid and the interaction between the two factors achieved significant differences in the second cutting fresh weight. The results showed in Table (3) that the spraying treatments with Moringa extract and Kinetin differed significantly among themselves in the percentage of the first

cutting dry matter the treatment M1 gave highest value (6.040%) while M0 gave lowest value (4.654%). As for the second factor, humic acid, H2 recorded the highest average of 6.296% and H0 the lowest average of 4.276%. As for the interaction, M2H2 recorded the highest average of 6.889 %, and M4H0 recorded the lowest average. 3,628 %

Table (3) Effect of Moringa leaf extract, Kinetin and humic acid and the interaction between them on the first cutting dry matter of Rocket plant for the fall season 2021-2022

Moringa extract average	Humic acid (H)			Moringa leaf extract g/ L (M)
	H ₂	H ₁	H ₀	
4.654	5.517	4.733	3.712	M ₀
6.040	6.328	6.221	5.570	M ₁
5.390	6.889	5.201	4.081	M ₂
5.437	6.736	5.184	4.391	M ₃
4.984	6.009	5.316	3.628	M ₄
	6.296	5.331	4.276	humic acid average
M*H	H		M	LSD 0.05
0.6433	0.2877		0.3714	

4- Percentage of dry matter for second cutting (kg):

The results in Table (4) that spraying treatments with Moringa extract, kinetin and humic acid and the interaction between the two factors achieved significant differences in the percentage of dry weight for the second cutting. The results showed in Table (4) that the spraying treatments with Moringa extract

and Kinetin differed significantly among themselves in the percentage of dry matter for the second cutting. In the first agent, M1 recorded the highest average of 6.896 %. M0 recorded the lowest average of 5.273 %, while in the second factor, humic acid, H2 recorded the highest average of 7.083 %, and H0 the lowest average of 5.007 %. As for the interaction, M3H2 recorded the highest average of 7.525 %, and M4H0 recorded the lowest average of 4.107%

Table (4) The effect of Moringa leaf extract, kinetin , and humic acid and the interaction between them on the second for cutting dry matter of Rocket plant for the autumn season 2021-2022

Moringa extract average	(humic acid (H			Moringa leaf extract (M)
	H ₂	H ₁	H ₀	
5.273	6.016	5.488	4.317	M ₀
6.896	7.243	7.066	6.378	M ₁
6.193	7.373	6.202	5.004	M ₂
5.752	7.525	4.504	5.228	M ₃
5.923	7.257	6.406	4.107	M ₄
	7.083	5.933	5.007	humic acid average
M*H	H		M	LSD 0.05
0.7551	0.3377		0.4359	

5- Plant yield per hectare (ton):

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It is noted from the results in Table (5) that the spraying treatments with Moringa extract, kinetin and humic acid and the interaction between the two factors achieved significant differences in the percentage of yield with the first cutting. The results showed in Table (5) that the treatments of spraying with Moringa extract and kinetin differed significantly among them in the percentage of yield in the first weed the treatment M4 gave highest value (2.252 ton/ha) while M1 gave lowest value (1.469 ton/ha). As for the second factor, humic acid, H1 recorded the highest average of 1.926 tons, and H0 the lowest average of 1.559 tons. As for the interaction, M4H2 recorded the highest average of 2.580 ton/ha, and M0H0 recorded the lowest average of 1.180 tons /ha.

Table (5) The effect of Moringa leaf extract, kinetin , and humic acid and the interaction between them on the yield of the first cutting of Rocket plant for autumn season 2021-2022

Moringa extract average	humic acid (H			Moringa leaf extract (M)
	H ₂	H ₁	H ₀	
1.513	1.733	1.627	1.180	M ₀ 1.469
1.503	M ₁ 1.836	1.450	2.300	1.757
1.990	1.790	1.590	M ₃	M ₂ 1.790
2.252	2.580	2.410	1.767	M ₄
	1.831	1.926	1.559	humic acid average
0.4210M*H	0.1883 H	0.2431 M	LSD 0.05	
Yield in the second cutting per hectare (ton):				

It is noted from the results of Table (6) that the spraying treatments with Moringa extract, kinetin and humic acid and the interaction between the two factors achieved significant differences in the percentage of the yield of the first cutting. The results showed in Table (6) that the treatments of spraying with Moringa extract and kinetin differed significantly among themselves in the percentage of yield in the second crop

treatment M4 gave highest value (1.737 ton/ha) while M0 gave lowest value (1.038 ton). As for the second factor, humic acid, H2 recorded the highest average of 1.464 tons/ha, and H0 the lowest average of 1.249 tons/ha. As for the interaction, M2H1 recorded the highest average of 2.093 tons/ha, and M0H0 recorded the lowest average of 0.710 tons/ha.

Table (6) The effect of Moringa leaf extract, kinetin, and humic acid and the interaction between them on the yield of the second cutting of Rocket plant for autumn season 2021-2022

Moringa extract average) humic acid (H			Moringa leaf extract (M)
	H ₂	H ₁	H ₀	
1.038	1.427	0.977	0.710	M ₀
1.063	0.997	0.890	1.303	M ₁
1.481	1.243	2.093	1.107	M ₂
1.564	1.780	1.590	1.323	M ₃
1.737	1.873	1.533	1.803	M ₄
	1.464	1.417	1.249	humic acid average
M*H	0.1191 ^H	0.1537 ^M	LSD 0.05	
	0.2663			

7-Discussion:

The results of the previous table showed a significantly exceeded in the vegetative growth traits of the plant Rocket for the autumn season, and the reason is due to the environmental conditions that were suitable for plant growth, especially in the initial stages of growth, and the long period of vegetative growth. It was found that the leaves of *M. oleifera* contain more vitamin A and C than carrots and oranges. It is also higher in calcium, iron, and potassium than milk, spinach, and bananas, respectively. Plus, these leaves contain a higher protein quality compared to milk and eggs, which makes them an excellent source of nutrition (14). Reports indicate that the plant parts, such

as the leaves, in the Moringa plant contain many amino acids, fatty acids, vitamins, and nutrients. The parts have been frequently used as herbal medicine. The parts are good sources of phytochemicals. It is considered one of the most important beneficial plants because it is a medicinal and nutritional plant (15). Spraying with kinetin had a significant effect on increasing the number of leaves in the two pots for autumn season. This may be due to the physiological roles of kinetin, which include promoting cell division, leaf bud development, and leaf growth. This is consistent with what was found by (16) that spraying with kinetin had a significant effect on increasing this trait for both animals in the

experimental season, where the effect increased as the concentration of spraying with kinetin increased. Spraying with kinetin had a significant effect on increasing leaves in the first litter. This may justify the total effects of kinetin, which is one of the boyhood hormones that work to prolong the life cycle of the plant. It also caused an increase in the number of branches and leaves in the plant, which led to the accumulation of additional amounts of carbohydrates in the leaves, which caused an increase in leaf productivity (17). Perhaps the reason for the increase in plant height is due to the action of humic acid, which improves the soil's chemical and physical trait, soil fertility, and biological trait, as well as an effect on the exchange capacity, so the readiness of nutrients increases, and the soil composition and aeration improves, so the roots breathe easily as a result of the increase in the soil area, thus facilitating the process of their growth and penetration into the soil. This large growth of the root system will be matched by a large vegetative growth (18). This large growth leads to an increase in plant height and the rest of the vegetative growth components as a result of the absorption of nutrients and their physiological action in increasing vegetative growth (19). As for the increase in the total number of leaves. A plant when reducing the plant density is due to the lack of competition between plants for the basic elements of growth represented by light and nutrients as well as irrigation. As a result, the efficiency of the carbon metabolism process is higher (20). Organic acids such as humic acid have an effective effect on plant growth and the availability of nutrients. As the use of humic acid in low concentrations leads to an increase in the permeability of cellular membranes, so the amounts of water and nutrients absorption are more effective in the plant, which helps the movement and transfer of minerals, and one of the important traits also of humic acid is the activity of plant enzymes (21)

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