Effect of Organic and bio fertilizer and spraying with nano zinc on the vegetative growth of Aswd Diyala fig seedlings

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Abstract
The experiment was conducted in lathhouse of Al-Mussaib technical college - Al-Furat Al-Awsat Technical University for the period from April 2023 to July 2024. To study the effect of organic and bio fertilization and spraying with nano zinc on the vegetative growth of Aswd Diyala fig seedlings (one year old) which were obtained from the Horticulture Department in Al-Hindiya / Karbala province the experiment included three factors, The first factor: - Organic fertilization Different types of organic fertilizer were used (control treatment, vermicompost at an average of 20 gpot-1, cow and sheep waste at an average of 20 gpot-1 + palm frond waste, wheat and rice at an average of 20 gpot-1) and symbolized by the symbol (A0, A1, A2) The second factor is spraying EM1, Sefo Alexi at three levels (without spraying (control treatment), spraying EM1 at a concentration of 5 ml/L, spraying Sefo Alexi 5 ml.L-1) and symbolized by (B0, B1, B2) The third work: Spraying nano zinc. Nano zinc is sprayed at three concentrations: (2, 1, 0 g. L-1) and its symbol is (N0, N1, N1). The results were summarized as follows: The results showed that the Organic fertilizers had a significant effect on the studied traits, as the animal and plant wastes (A2) had a significantly excelled and gave the highest rate for the traits of the percentage of nitrogen, phosphorus and potassium in the leaves (2.14, 0.42, 3.00%) respectively, for the content of zinc in the leaves 11.74 mg kg-1, the content of iron in the leaves 142.83 mg kg-1, the content of carbohydrates in the leaves 30.45 mg 100 g -1 dry weight . The results also showed that the biofertilizers had a significant effect on the studied traits, as the treatment of biofertilizer EM1 had a significantly excelled and recorded the highest rates for the traits of the percentage of nitrogen, phosphorus and potassium in the leaves (2.01, 0.40, 2.89%) respectively, and the content of zinc in the leaves, the content of iron in the leaves, The carbohydrate content in the leaves reached (11.34 mg kg-1, 140.59 mg kg-1, 27.58 mg 100 g -1 dry weight respectively. The treatment of spraying nano zinc at a concentration of 2 g L-1 (N2) was significantly excelled and recorded the highest rates for the characteristics of leaf content of elements. The results showed that the triple interaction between the experimental factors had a significant effect, as the interaction treatment A2B1N2 was significantly excelled and recorded the highest rate of traits for the percentage of nitrogen, phosphorus and potassium in the leaves (2.79, 0.64, 4.01%) respectively, for the zinc content of the leaves 14.39 mg kg-1, the iron content of the leaves 163.91 mg kg-1, and the carbohydrate content in the leaves 41.98%.

Key word: bio fertilizer , nano zinc, Aswd Diyala ,EM1

Introduction

The genus Ficus is one of 40 genera of the Moraceae family. The original home of figs is Western Asia and its cultivation has spread to the Mediterranean basin and the fertile part of the Arabian Peninsula. It still grows in its wild state and from there it spread to southern Syria and then to the shores of the Mediterranean.

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At present, its cultivation has spread to different regions of the world, including Turkey, Egypt, Spain, Greece, America, Italy, Brazil and other places in the world [1]. Figs are one of the medicinal plants known since ancient times because they have multiple medical and therapeutic benefits, as they contain vitamins in reasonable quantities such as vitamin B1, B2, B5, citric acid, ascorbic acid, vitamin D2, D3, and vitamin E, in addition to minerals such as phosphorus, iron, sodium, and potassium, in addition to small amounts of proteins, fats, and carbohydrates [2]. Therefore, it has multiple uses, as its fruits are used to treat abscesses, while fruit juice is given to treat constipation, indigestion, relieve headaches, and treat intestinal infections resulting from bacterial and parasitic infections [3]. While the soft pulp of the fruit is useful for treating tumors and gum abscesses, treating dry and irritated coughs, and bronchitis [4]. The world has recently turned to using organic fertilizers to reduce pollution to plants, humans and the environment by using natural materials [5]. Adding organic waste has a positive effect on the physical and chemical properties of the soil, including plant and animal waste. Organic matter is a source of supplying plants with the nutrients necessary for their growth, in addition to improving soil porosity, regulating the movement of water and air, the spread of gases, increasing the soil's ability to retain water, raising the cation exchange capacity (C.E.C.) and reducing soil pH. Organic compounds work to chelate the nutrient and prevent its deposition in the soil, thus increasing its availability, especially minor elements. The slow decomposition of organic matter will provide the plant with nutrients for a sufficient period of time [6]. Biofertilizers are among the types that have received wide attention in modern research because they are inexpensive and environmentally friendly compared to mineral fertilizers, which play an important role in plant growth and development [7]. EM1 is an abbreviation for (Effective Micro-organism) and is a natural preparation produced by the Japanese company Emro and contains a compatible group of beneficial microorganisms that have an active and effective role in improving the fertility of agricultural soil [8] and it is a safe preparation from a health perspective as the microorganisms in it are not genetically modified and do not contain harmful substances. It was prepared by the scientist Higa in the early eighties and called it EM1 and that this biological solution EM1 consists of a large group of microorganisms, which are [9] As for nano-fertilizers, they are characterized by unique properties due to their small size and large surface area that lead to an increase in the absorption surface and thus increase the process of photosynthesis and thus increase production in the plant ([10]. The research aims to know Effect of Organic and bio fertilizer and spraying with nano zinc on the vegetative growth of Aswd Diyala fig seedlings

Materials and methods

The experiment was conducted in lathhouse of Al-Mussaib technical college - Al-Furat Al-Awsat Technical University for the period from April 2023 to July 2024.to study the effect of organic and bio fertilization and spraying with nano zinc on the vegetative growth of Aswd Diyala fig seedlings

Preparing the seedlings

One-year-old fig seedlings (Aswd Diyala cultivar) were brought and obtained from the Horticulture Department in Al-Hindiya / Karbala provainc. They were planted in plastic

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bags measuring (30*25) cm. 324 seedlings were selected that were as homogeneous in growth and size as possible. The service operations were conducted equally for all treatments. The soil will be analyzed to determine some of its physical and chemical properties according to the methods mentioned in [11,12.[

The experiment included three factors,

The first factor: - Organic fertilization Different types of organic fertilizer were used (control treatment, vermicompost at an average of 20 gpot-1, cow and sheep waste at an average of 20 gpot-1 + palm frond waste, wheat and rice at an average of 20 gpot-1) and symbolized by the symbol (A0, A1, A2) The second factor: Spraying EM1, Sefo Alexi at three levels (without spraying (control treatment), spraying EM1 at a concentration of 5 ml.L-1, spraying Sefo Alexi 5 ml.L-1) and symbolized by (B0, B1, B2) The third work: - Spraying nano zinc Nano zinc was sprayed at three concentrations (2, 1, 0 g L -1) and symbolized by (N0, N1, N1(

Table (1): Some chemical and physical properties of the soil

values	units	Soil separators
608	$g.kg^{-1}soil$	sand
287	$g.kg^{-1}soil$	Silt
105	$g.kg^{-1}soil$	clay
Sand loamy	--------	texture
values	units	traits
2.35	$DS.m^{-2}$	Electrical conductivity EC
7.60	---------	pH
3.89	$g.kg^{-1}$	available nitrogen
4.10	$mg.kg^{-1}$	available phosphorus
3.15	$mg.kg^{-1}$	available potassium

Experimental design and treatments Experiment

The research will be implemented as a general experiment (3*3*3) (Completely Randomized Design) with three replicates, each replicate includes 81 seedlings with 3 seedlings for each experimental unit and three factors. The averages were compared according to the Least Significant Difference (LSD) test.

Studied traits:

Nutrient content of leaves (nitrogen, phosphorus, potassium(

Fully mature fresh leaves were taken from each plant and each replicate and washed well with running water, then washed with distilled water to remove dust and dirt stuck to them, and placed in perforated paper bags and then dried in an electric oven at a temperature of 70 degrees Celsius for 72 hours until the weight was fixed, after which the samples were ground using an electric mill and 0.2 g of sample powder (dry leaves) was taken and digested by adding (3 ml of sulfuric acid) and (1 ml of perchloric acid) using a digestion device equipped by the German company Siemens at a temperature of (240 °C) for two hours, and after completing the digestion process, distilled water was added for cooling and the solution was filtered on filter papers and the filtrate was completed to 50 ml, [13]and stored in plastic containers with the name of the treatment written on them Until the rest of the elements are estimated, these elements were estimated in the laboratory of the Department of Horticulture - College of Agriculture - Al-Qasim Green University as follows- :

-1The percentage of nitrogen in the leaves

Nitrogen was estimated using the Microkjedhal device according to the method of [14[

-2The percentage of phosphorus in the leaves

Phosphorus was estimated by the soft digestion method using ammonium molybdate and ascorbic acid in the Spectrophotometer [15[

-3The percentage of potassium in the leaves

Potassium was estimated using the Flame-Photometer according to the method followed by [16[

Iron and zinc content of leaves (mg kg-1 dry matter(

The concentrations of the two elements in the dry matter were estimated according to the method of Pratt and Chapman, 1961 (directly based on the standard solution of each element using an atomic absorption spectrometer and by applying the equation below, the concentration of each element was estimated:

Fe, Zn (ppm) = ppm Fe, Zn, Mn or Cu (from calibration curve)×v/wt

– 2-4-5-3Carbohydrate content in leaves (mg 100 g-1 dry weight(

It was calculated according to the method of [17] where 0.2 g of the dried, ground sample of leaves was taken from each replicate and 8 ml of ethyl alcohol, 80% concentration, was added to it, then placed in a water bath at 60°C for 30 minutes, then centrifugation was carried out for 15 minutes at a speed of 3000 cycles/second and the filtrate was withdrawn and these steps were repeated three times (8 + 8 + 8), then the clear solution (filtrate) was collected in a volumetric flask and the volume was completed to 25 ml by adding ethyl alcohol and 1 ml of the diluted solution was taken and 1 ml of phenol solution with a concentration of 5% and 5 ml of concentrated sulfuric acid was added to it, then the light absorption was read by a spectrophotometer at a wavelength of 560 nm, and the concentration of soluble carbohydrates was extracted based on the standard curve of pure glucose prepared by dissolving different concentrations of glucose (2, 4, 6, 8, 10) mg in (100) ml of distilled water, then (1) ml was taken from each solution and 5)) ml of concentrated sulfuric acid was added to it, then the light absorption readings were taken at a wavelength of 560 nm for each solution, and the data were recorded to make the curve Standard glucose, then the percentage of soluble carbohydrates was calculated after multiplying the values by the final volume of the sample (25) and dividing by the value of the sample weight (0.2.(

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Results and discussion

The percentage of nitrogen in the leaves

The results in Table (2) showed that the Organic fertilizers had a significant effect on the percentage of nitrogen in the leaves (%). Animal and plant wastes (A2) were significantly excelled and gave the highest rate of nitrogen percentage in the leaves, reaching 2.14% compared to the comparison treatment (A0), the lowest percentage of nitrogen in the leaves, reaching 1.29%.

The results also showed that biofertilizers had a significant effect on the percentage of nitrogen in the leaves. The addition of EM1 at a rate of 5 ml L-1 (B1) was significantly excelled to the other treatments and gave the highest rate of nitrogen percentage in the leaves, reaching 2.01%, while the treatment without addition (B0) gave the lowest rate of nitrogen percentage in the leaves, reaching 1.46%. The results also showed that nano zinc spray had a significant effect on the percentage of nitrogen in the leaves. The nano zinc spray treatment at a concentration of 2 g L-1 (N2) was significantly excelled and recorded the highest rate of nitrogen percentage in the leaves, reaching 1.97%, while the treatment without spray (0N) recorded the lowest rate of plant height, reaching 1.60%. The results also showed that the double interaction had a significant effect on the percentage of nitrogen in the leaves. The interaction treatment between A2B1 was significantly excelled and recorded the highest rate of nitrogen percentage in the leaves, reaching 2.47%, while the interaction treatment A0B0 recorded and gave the lowest rate of nitrogen percentage in the leaves, reaching 1.09%. The results also showed that the interaction treatment A2N2 was excelled and recorded the highest rate of nitrogen percentage in the leaves, reaching 2.36%, while the interaction treatment A0N0 gave and recorded the lowest rate of nitrogen percentage in the leaves, reaching 1.18%. As for the interaction treatment B1N2, it gave the highest rate of nitrogen percentage in the leaves, reaching 2.21%, while the interaction treatment composed of B0N0 recorded and gave the lowest rate of nitrogen percentage in the leaves, reaching 1.20%. The results of Table (2) also showed that the triple interaction between the experimental factors had a significant effect on the percentage of nitrogen in the leaves. The interaction treatment A2B1N2 significantly excelled the other interaction treatments and gave the highest percentage of nitrogen in the leaves, reaching 2.79%. While the interaction treatment A0B0N0 recorded the lowest rate of nitrogen percentage in the leaves, reaching 1.02%.

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Table (2) Effect of Organic fertilizers, biofertilizers, nano zinc spraying and their interaction on the percentage of nitrogen in the leaves

A x B	Nano Zinc (g L-1) **(N(** 2 g/L-1(N2)	1g/L-1(N1)	Without adding)N0(	Biofertilizers) B(	Organic fertilizer (A)(A(
1.09	1.17	1.08	1.02	**Without adding (B0)**	**control**) **A0**(
1.41	1.54	1.42	1.27	**(B1)EM1**	
1.37	1.46	1.40	1.25	**macrobin (B2)**	
1.60	1.87	1.67	1.27	**Without adding (B0)**	**Virmicompost A1)**(
2.17	2.32	2.22	1.97	**(B1)EM1**	
2.10	2.29	2.07	1.95	**macrobin (B2)**	
1.68	1.92	1.80	1.32	**Without adding (B0)**	**Animal and plant waste**) **A2**(
2.47	2.79	2.42	2.20	**(B1)EM1**	
2.26	2.37	2.26	2.17	**macrobin (B2)**	
0.10	0.18			**L.S.D 0.05**	
Organic fertilizer (A (A)**(**	Interaction between Organic fertilizer (A) and zinc spraying**)** A×N**(**				
1.29	1.39	1.30	1.18	**A0**	
1.96	2.16	1.98	1.73	**A1**	
2.14	2.36	2.16	1.89	**A2**	
0.06	0.10			**L.S.D 0.05**	
Biofertilizers**)** B**(**	Interaction between Organic fertilizer (A) and Biofertilizers) N×B**(**				
1.46	1.65	1.52	1.20	**Without adding (B0)**	
2.01	2.21	2.02	1.81	**EM1 (B1**(	
1.91	2.04	1.91	1.787	**macrobin (B2)**	
0.06	0.10			**L.S.D 0.05**	
	1.97	1.81	1.60	Nano Zinc (g L-1) **(N(**	
	0.06			**L.S.D 0.05**	

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The percentage of phosphorus in the leaves

The results in Table (3) showed that the Organic fertilizers had a significant effect on the percentage of phosphorus in the leaves (%), as animal and plant wastes (A2) were significantly excelled and gave the highest rate of the percentage of phosphorus in the leaves, reaching 0.42%, compared to the comparison treatment (A0), which had the lowest percentage of phosphorus in the leaves, reaching 0.18%.

The results also showed that biofertilizers had a significant effect on the percentage of phosphorus in the leaves. The addition of EM1 at a rate of 5 ml L-1 (B1) was significantly excelled to the other treatments and gave the highest rate of phosphorus percentage in the leaves, reaching 0.40%. The treatment without addition (B0) recorded the lowest rate, reaching 0.21%. The results also showed that nano zinc spray had a significant effect on the percentage of phosphorus in the leaves. The treatment of nano zinc spray at a concentration of 2 g L-1 (N2) was significantly excelled and recorded the highest rate of phosphorus percentage in the leaves, reaching 0.39%, while the treatment without spray (0N) recorded the lowest rate, reaching 0.24%. The results also showed that the binary interaction had a significant effect on the percentage of phosphorus in the leaves. The interaction treatment between A2B1 was significantly excelled and recorded the highest percentage of phosphorus in the leaves, reaching 0.56%, while the interaction treatment A0B0 recorded the lowest percentage of phosphorus in the leaves, reaching 0.18%. The results also showed that the interaction treatment A2N2 was excelled and recorded the highest percentage of phosphorus in the leaves, reaching 0.51%, while the interaction treatment A0N0 recorded the lowest percentage of phosphorus in the leaves, reaching 0.16%. The interaction treatment B1N2 gave the highest percentage of phosphorus in the leaves, reaching 0.48%, while the interaction treatment composed of B0N0 recorded the lowest percentage of phosphorus in the leaves, reaching 0.17%. The results of Table (3) also showed that the triple interaction between the experimental factors had a significant effect on the percentage of phosphorus in the leaves. The interaction treatment A2B1N2 significantly excelled the other interaction treatments and gave the highest percentage of phosphorus in the leaves, reaching 0.64%. While the interaction treatment A0B0N0 recorded the lowest rate, reaching 0.17% .

Table (3) Effect of Organic fertilizers, biofertilizers, nano zinc spraying and their interaction on the percentage of phosphorus in the leaves

A x B	Nano Zinc (g L-1) **(N(**			Biofertilizers) B**(**	Organic fertilizer (A)(A**(**
	2**g/L-1(N2(**	1**g/L-1(N1(**	**Without adding)N0(**		
0.18	0.18	0.18	0.17	**Without adding (B0)**	**control**) **A0**(
0.19	0.22	0.20	0.16	**(B1)EM1**	
0.18	0.21	0.18	0.16	**macrobin (B2)**	

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0.21	0.25	0.23	0.17	**Without adding (B0)**	**Virmicompost A1)(**
0.43	0.57	0.43	0.31	**(B1)EM1**	
0.39	0.53	0.36	0.28	**macrobin (B2)**	
0.23	0.27	0.24	0.18	**Without adding (B0)**	**Animal and plant waste) A2(**
0.56	0.64	0.68	0.38	**(B1)EM1**	
0.48	0.63	0.48	0.35	**macrobin (B2)**	
0.05	0.09			**L.S.D 0.05**	
Organic fertilizer (A (A)(	Interaction between Organic fertilizer (A) and zinc spraying) A×N(				
0.18	0.20	0.18	0.16	**A0**	
0.34	0.45	0.34	0.25	**A1**	
0.42	0.51	0.46	0.30	**A2**	
0.03	0.05			**L.S.D 0.05**	
Biofertilizers) B(	Interaction between Organic fertilizer (A) and Biofertilizers) N×B(				
0.21	0.23	0.21	0.17	**Without adding (B0)**	
0.40	0.48	0.43	0.28	**EM1 (B1(**	
0.35	0.45	0.34	0.26	**macrobin (B2)**	
0.03	0.05			**L.S.D 0.05**	
	0.39	0.33	0.24	Nano Zinc (g L-1) **(N(**	
	0.03			**L.S.D 0.05**	

The percentage of potassium in the leaves

The results in Table (4) showed that the Organic fertilizers had a significant effect on the percentage of potassium in the leaves (%). Animal and plant wastes (A2) were significantly excelled and gave the highest rate of potassium percentage in the leaves, reaching 3.00%, compared to the comparison treatment (A0), which had the lowest percentage of potassium in the leaves, reaching 1.96%.

The results also showed that biofertilizers had a significant effect on the percentage of potassium in the leaves. The addition of EM1 at a rate of 5 ml L-1 (B1) was significantly excelled to the other treatments and gave the highest rate of potassium percentage in the leaves, reaching 2.89%, while the treatment without addition (B0) gave the lowest rate, reaching 2.07%. The results also showed that nano zinc spray had a significant effect on the percentage of potassium in the leaves. The nano zinc spray treatment at a concentration of

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2 g L-1 (N2) was significantly excelled and recorded the highest rate of potassium percentage in the leaves, reaching 2.80%, while the treatment without spray (0N) recorded the lowest rate, reaching 2.25%. The results also showed that the binary interaction had a significant effect on the percentage of potassium in the leaves. The interaction treatment between A2B1 was significantly excelled and recorded the highest rate of potassium percentage in the leaves, reaching 3.54%, while the interaction treatment A0B0 recorded the lowest rate, reaching 1.66%. The results also showed that the interaction treatment A2N2 was excelled and recorded the highest rate of potassium percentage in the leaves, reaching 3.29%, while the interaction treatment A0N0 recorded the lowest rate, reaching 1.76%. As for the interaction treatment B1N2, it gave the highest rate of potassium percentage in the leaves, reaching 3.19%, while the interaction treatment composed of B0N0 recorded the lowest rate, reaching 1.82%. The results of Table (4) showed that the interaction treatment A2B1N2 was significantly excelled to the other interaction treatments and gave the highest percentage of potassium in the leaves, reaching 4.01%. While the interaction treatment A0B0N0 recorded the lowest, reaching 1.55%.

Table (4) Effect of Organic fertilizers, biofertilizers, nano zinc spraying and their interaction on the percentage of potassium in the leaves

A x B	Nano Zinc (g L-1) **(N(**			Biofertilizers) B**(**	Organic fertilizer (A)(A**(**
	2**g/L-1(N2**(	1**g/L-1(N1**(	**Without adding**)**N0**(		
1.66	1.73	1.68	1.55	**Without adding (B0)**	**control**) **A0**(
2.13	2.28	2.23	1.88	**(B1)EM1**	
2.10	2.26	2.21	1.83	**macrobin (B2)**	
2.23	2.48	2.33	1.88	**Without adding (B0)**	**Virmicompost A1)**(
3.00	3.28	3.08	2.63	**(B1)EM1**	
2.84	3.23	2.73	2.54	**macrobin (B2)**	
2.31	2.53	2.38	2.01	**Without adding (B0)**	**Animal and plant waste**) **A2**(
3.54	4.01	3.63	2.98	**(B1)EM1**	
3.14	3.33	3.21	2.88	**macrobin (B2)**	
0.02	0.04			**L.S.D 0.05**	
Organic fertilizer (A **(A)(**	Interaction between Organic fertilizer (A) and zinc spraying**)** A×N**(**				
1.96	2.09	2.04	1.76	**A0**	
2.69	3.00	2.72	2.35	**A1**	

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3.00	3.29	3.08	2.63	**A2**
0.01	0.02			**L.S.D 0.05**
Biofertilizers**)** B**(**	Interaction between Organic fertilizer (A) and Biofertilizers**)** N×B**(**			
2.07	2.25	2.13	1.82	**Without adding (B0)**
2.89	3.19	2.98	2.50	**EM1 (B1**(
2.69	2.94	2.72	2.42	**macrobin (B2)**
0.01	0.02			**L.S.D 0.05**
	2.80	2.61	2.25	Nano Zinc (g L-1) **(N**(
	0.01			**L.S.D 0.05**

Zinc content of leaves (mg kg-1(

The results in Table (5) showed that the Organic fertilizers had a significant effect on the zinc content of leaves (mg kg-1). Animal and plant wastes (A2) were significantly excelled and gave the highest rate of zinc content of leaves, reaching 11.74 mg kg-1, compared to the comparison treatment (A0), the lowest rate of 8.80 mg kg-1. The results also showed that biofertilizers had a significant effect on the zinc content of leaves. The addition of EM1 at a rate of 5 ml L-1 (B1) was significantly excelled to the other treatments and gave the highest rate of zinc content of leaves, reaching 11.34 mg kg-1, while the treatment without addition (B0) gave the lowest rate, reaching 9.25 mg kg-1. The results also showed that nano zinc spray had a significant effect on the zinc content of leaves. The nano zinc spray treatment at a concentration of 2 g L-1 (N2) was significantly excelled and recorded the highest rate of zinc content of leaves, reaching 11.29 mg kg-1, while the treatment without spray (0N) recorded the lowest rate, reaching 9.65 mg kg-1. The results also showed that the binary interaction had a significant effect on the zinc content of the leaves. The interaction treatment between A2B1 was significantly excelled and recorded the highest rate of zinc content of the leaves, which amounted to 13.10 mg kg-1, while the interaction treatment A0B0 recorded the lowest rate of 8.02 mg kg-1. The results also showed that the interaction treatment A2N2 was excelled and recorded the highest rate of zinc content of the leaves, which amounted to 12.74 mg kg-1, while the interaction treatment A0N0 recorded the lowest rate of 8.30 mg kg-1. The interaction treatment B1N2 gave the highest rate of zinc content of the leaves, which amounted to 12.26 mg kg-1, while the interaction treatment composed of B0N0 recorded the lowest rate of 8.52 mg kg-1. The results of Table (5) also showed that the triple interaction between the experimental factors had a significant effect on the zinc content of the leaves. The interaction treatment A2B1N2 significantly excelled the other interaction treatments and gave the highest zinc content of the leaves, reaching 14.39 mg kg-1. While the interaction treatment A0B0N0 recorded the lowest zinc content of the leaves, reaching 7.77 mg kg-1 .

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Table (5) Effect of Organic fertilizers, biofertilizers, nano zinc spraying and their interaction on the zinc content of the leaves (mg kg-1(

A x B	Nano Zinc (g L-1) **(N(**			Biofertilizers**)** B**(**	Organic fertilizer (A)(A(
	2**g/L-1(N2**(	1**g/L-1(N1**(	**Without adding**)**N0**(		
8.02	8.27	8.02	7.77	**Without adding (B0)**	**control**) **A0**(
9.25	9.77	9.37	8.62	**(B1)EM1**	
9.12	9.62	9.22	8.52	**macrobin (B2)**	
9.77	10.57	9.97	8.77	**Without adding (B0)**	**Virmicompost A1)**(
11.65	12.62	11.52	10.82	**(B1)EM1**	
11.41	12.50	10.97	10.77	**macrobin (B2)**	
9.97	10.62	10.27	9.02	**Without adding (B0)**	**Animal and plant waste**) **A2**(
13.10	14.39	13.52	11.39	**(B1)EM1**	
12.15	13.21	12.06	11.17	**macrobin (B2)**	
0.45	0.89			**L.S.D 0.05**	
Organic fertilizer (A (A)**(**	Interaction between Organic fertilizer (A) and zinc spraying**)** A×N**(**				
8.80	9.22	8.87	8.30	**A0**	
10.95	11.9	10.82	10.12	**A1**	
11.74	12.74	11.95	10.53	**A2**	
0.21	0.45			**L.S.D 0.05**	
Biofertilizers**)** B**(**	Interaction between Organic fertilizer (A) and Biofertilizers) N×B**(**				
9.25	9.82	9.42	8.52	**Without adding (B0)**	
11.34	12.26	11.47	10.28	**EM1 (B1**(	
10.89	11.78	10.75	10.15	**macrobin (B2)**	
0.21	0.45			**L.S.D 0.05**	
	11.29	10.55	9.65	Nano Zinc (g L-1) **(N(**	
	0.21			**L.S.D 0.05**	

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Iron content of leaves (mg kg-1(

The results in Table (6) showed that the Organic fertilizers had a significant effect on the iron content of leaves (mg kg-1). Animal and plant wastes (A2) were significantly excelled and gave the highest rate of iron content of leaves, reaching 142.83 mg kg-1, compared to the comparison treatment (A0), which had the lowest rate of iron content, reaching 121.48 mg kg-1.

The results also showed that biofertilizers had a significant effect on the iron content of leaves. The addition of EM1 at a rate of 5 ml L-1 (B1) was significantly excelled to the other treatments and gave the highest rate of iron content of leaves, reaching 140.59 mg kg-1. The treatment without addition (B0) recorded the lowest rate, reaching 124.46 mg kg-1. The results also showed that nano zinc spray had a significant effect on the iron content of leaves. The nano zinc spray treatment at a concentration of 2 g L-1 (N2) was significantly excelled and recorded the highest rate of iron content of leaves, reaching 139.01 mg kg-1, while the treatment without spray (0N) recorded the lowest rate, reaching 127.85 mg kg-1. The results also showed that the double interaction had a significant effect on the iron content of the leaves. The interaction treatment between A2B1 was significantly excelled and recorded the highest rate of iron content of the leaves, which amounted to 153.84 mg kg-1, while the interaction treatment A0B0 recorded the lowest rate, which amounted to 115.94 mg kg-1. The results also showed that the interaction treatment A2N2 was excelled and recorded the highest rate of iron content of the leaves, which amounted to 150.37 mg kg-1, while the interaction treatment A0N0 recorded the lowest rate, which amounted to 117.50 mg kg-1. The interaction treatment B1N2 gave the highest rate of iron content of the leaves, which amounted to 146.91 mg kg-1, while the interaction treatment composed of B0N0 recorded the lowest rate, which amounted to 118.63 mg kg-1. The results of Table (6) also showed that the triple interaction between the experimental factors had a significant effect on the iron content of the leaves. The interaction treatment A2B1N2 significantly excelled the other interaction treatments and gave the highest iron content of the leaves, reaching 163.91 mg kg-1. While the interaction treatment A0B0N0 recorded the lowest rate, reaching 112.88 mg kg-1 .

Table (6) Effect of Organic fertilizers, biofertilizers, nano zinc spraying and their interaction on the iron content of the leaves (mg kg-1(

A x B	Nano Zinc (g L-1) **(N(**			Biofertilizers**)** B**(**	Organic fertilizer (A **)(**A**(**
	2 **g/L-1(N1(**	1**g/L-1(N1(**	**Without adding**)**N0(**		
115.94	118.06	116.88	112.88	**Without adding (B0)**	**control**) **A0(**
125.32	128.64	126.77	120.55	**(B1)EM1**	
123.18	127.93	122.55	119.06	**macrobin (B2)**	

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127.80	132.61	129.84	120.94	**Without adding (B0)**	**Virmicompost A1)(**
142.62	148.17	142.06	137.64	**(B1)EM1**	
139.88	144.55	138.64	136.44	**macrobin (B2)**	
129.63	134.77	132.06	122.06	**Without adding (B0)**	**Animal and plant waste) A2(**
153.84	163.91	156.55	141.06	**(B1)EM1**	
145.00	152.42	142.55	140.04	**macrobin (B2)**	
0.52	0.90			**L.S.D 0.05**	
Organic fertilizer (A (A)(	Interaction between Organic fertilizer (A) and zinc spraying) A×N(				
121.48	124.88	122.07	117.50	**A0**	
136.77	141.777	136.847	131.673	**A1**	
142.83	150.368	143.72	134.387	**A2**	
0.30	0.52			**L.S.D 0.05**	
Biofertilizers) B(	Interaction between Organic fertilizer (A) and Biofertilizers) N×B(				
124.46	128.48	126.26	118.63	**Without adding (B0)**	
140.59	146.91	141.79	133.08	**EM1 (B1(**	
136.02	141.63	134.58	131.85	**macrobin (B2)**	
0.30	0.52			**L.S.D 0.05**	
	139.007	134.211	127.852	Nano Zinc (g L-1) **(N(**	
	0.30			**L.S.D 0.05**	

Leaf carbohydrate content (mg/100gm-1dry weight(

The results in Table (7) showed that the Organic fertilizers had a significant effect on the leaf carbohydrate content. Animal and plant wastes (A2) were significantly excelled and gave the highest rate of leaf carbohydrate content, reaching 30.45 mg/100gm-1dry weight, compared to the comparison treatment (A0), the lowest rate, reaching 13.01 mg/100gm-1dry weight.

The results also showed that biofertilizers had a significant effect on the carbohydrate content of leaves. The addition of EM1 at a rate of 5 ml L-1 (B1) was significantly excelled to the other treatments and gave the highest rate of carbohydrate content in leaves, reaching 27.58 mg 100 g-1 dry weight, while the treatment without addition (B0) gave the lowest rate, reaching 17.23 mg 100 g-1 dry weight. The results also showed that nano zinc spray had a significant effect on the carbohydrate content in leaves. The nano zinc spray treatment at a concentration of 2 g L-1

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(N2) was significantly excelled and recorded the highest rate of carbohydrate content in leaves, reaching 26.79%, while the treatment without spray (0N) recorded the lowest rate, reaching 19.75 mg 100 g-1 dry weight. The results also showed that the binary interaction had a significant effect on the carbohydrate content in the leaves. The interaction treatment between A2B1 was significantly excelled and recorded the highest rate of carbohydrate content in the leaves, reaching 36.70 mg 100 g-1 dry weight, while the interaction treatment A0B0 recorded and gave the lowest rate, reaching 10.75%. The results also showed that the interaction treatment A2N2 was excelled and recorded the highest rate of carbohydrate content in the leaves, reaching 34.91 mg 100 g-1 dry weight, while the interaction treatment A0N0 gave and recorded the lowest rate, reaching 11.33 mg 100 g-1 dry weight. As for the interaction treatment B1N2, it gave the highest rate of carbohydrate content in the leaves, reaching 30.82 mg 100 g-1 dry weight, while the interaction treatment composed of B0N0 recorded and gave the lowest rate, reaching 12.28 mg 100 gm-1 dry weight.

The results of the same table also showed that the triple interaction between the experimental factors had a significant effect on the percentage of carbohydrates in the leaves, as the interaction treatment A2B1N2 significantly excelled the rest of the other interaction treatments and gave the highest rate of carbohydrate content in the leaves, reaching 41.98 mg 100 gm-1 dry weight. While the interaction treatment A0B0N0 recorded the lowest rate, reaching 10.33 mg 100 gm-1 dry weight.

Table (7) Effect of Organic fertilizers, biofertilizers, nano zinc spraying and their interaction on the carbohydrate content of the leaves (mg 100 gm-1 dry weight(

A x B	Nano Zinc (g L-1) **(N(**			Biofertilizers) B**(**	Organic fertilizer (A)**(A(**
	2**g/L-1(N2**(	1**g/L-1(N1**(	**Without adding**)**N0**(		
10.75	11.11	10.81	10.33	**Without adding (B0)**	**control**) **A0**(
14.35	15.78	15.12	12.15	**(B1)EM1**	
13.94	15.53	14.76	11.52	**macrobin (B2)**	
19.90	24.57	22.22	12.91	**Without adding (B0)**	**Virmicompost A1)**(
31.69	34.70	31.95	28.41	**(B1)EM1**	
30.74	34.67	29.56	28.00	**macrobin (B2)**	
21.04	26.00	23.50	13.61	**Without adding (B0)**	**Animal and plant waste**) **A2**(
36.70	41.98	37.75	30.38	**(B1)EM1**	
33.62	36.74	33.66	30.45	**macrobin (B2)**	
0.2482	0.43			**L.S.D 0.05**	
Organic fertilizer	Interaction between Organic fertilizer (A) and zinc spraying**)** A×N**(**				

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(A (A)(				
13.01	14.14	13.56	11.33	**A0**
27.44	31.314	27.912	23.106	**A1**
30.45	34.906	31.638	24.813	**A2**
0.1433	0.2482			**L.S.D 0.05**
Biofertilizers) B(	Interaction between Organic fertilizer (A) and Biofertilizers) N×B(			
17.23	20.56	18.84	12.28	**Without adding (B0)**
27.58	30.82	28.27	23.64	**EM1 (B1**(
26.10	28.98	25.99	23.32	**macrobin (B2)**
0.1433	0.2482			**L.S.D 0.05**
	26.787	24.371	19.750	Nano Zinc (g L-1) **(N**(
	0.1433			**L.S.D 0.05**

The results of Tables (2-7) showed that the organic medium (animal and plant waste) (A2) was significantly excelled in increasing the percentage of elements in nitrogen, phosphorus, potassium, zinc, iron, and leaf content of carbohydrates, auxin, and gibberellin. This is attributed to the importance of organic matter, which is an important source of major and minor nutrients necessary for plant growth, and the availability of humus, which is a colloidal substance charged with a negative charge, which causes the attraction of positive ketones and prevents the loss of nutrients through washing by irrigation and improves soil properties by mineralizing or preventing the fixation of elements [18] These elements play an important role in the various vital processes within the plant, and this was reflected in increasing the efficiency of the root system in absorbing elements, especially nitrogen (Table 2). This is attributed to the fact that organic matter increases the availability of nutrients, which is positively reflected in plant growth and production. These results are consistent with [19]. The reason for the increase may be attributed to the fact that Organic matter is a mixture of macro and micro elements essential for growth such as nitrogen, phosphorus, potassium, iron, etc. Increasing its concentration to a certain extent leads to its absorption by the plant and thus increasing its content in the leaves [20] The results are consistent with [21] The organic fertilizer contains a percentage of nitrogen, which caused an increase in the percentage of nitrogen in the leaves, so the photosynthesis process was activated and the number of leaves and leaf area increased, thus increasing the efficiency of the absorption of nutrients, which increased the nitrogen content of the leaves. The increase in the level of phosphorus in the leaves, Table (3), can be attributed to the fact that organic acids and mineral nutrients present in organic fertilizer have an important role in the activity of vegetative growth, which caused a larger amount of phosphorus to be withdrawn to meet the plant's need to form cell membranes such as the plasma membrane, mitochondria and

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chloroplasts, in addition to its entry into the formation of some energy-rich compounds that are considered cofactors for enzymes [22]. These results are consistent with [23] Humic and folic acids resulting from the decomposition of organic fertilizer, which work to dissolve minerals containing potassium and accumulate in the leaves [24] (Table 5) The increase in phosphorus absorption may be attributed to the role of organic matter in increasing the availability of phosphorus in the growth medium, which increases and thus increases the concentration of phosphorus in the leaves (Table 4). The increase in the abundance of nutrients and their absorption due to the efficiency of the root system leads to an increase in the amount of photosynthesis in the plant, which is positively reflected in the manufacture of nutrients, especially carbohydrates, and their accumulation in the leaves (Table 5). The reason for the increase in the percentage of zinc in the leaves is due to the increase in vegetative growth, which resulted in an increase in zinc absorption to meet the plant's need for this element, as it participates in the special processes in the formation of the amino acid Tryptophan, which is necessary for cell elongation and helps in the process of photosynthesis and the formation of RNA, which is necessary in the process of protein formation. Zinc also activates a number of important enzymes in vital processes [25]. It may also be due to direct spraying of nano zinc, thus increasing absorption. The reason may also be attributed to the fact that soil addition and good root system construction had a positive effect on increasing the efficiency of absorption of major and minor nutrients and improving plant growth [26] The reason may also be attributed to the fact that soil addition contributed to increasing the efficiency of iron absorption from the roots and thus increasing its percentage in the leaves, in addition to increasing the ability of the roots to absorb nutrients from the soil when adding organic fertilizers because it increases the effectiveness of the roots and increases their respiration and thus produces the energy necessary to absorb some nutrients, and as a result, plant growth and production improve [27]. These elements are also absorbed by plant roots and their ions are easily released and quickly transferred for the plant to benefit from them by participating in physiological processes and providing them to the plant [28]. It may be attributed to the effect of increasing plant hormones such as auxin (Table (8)) in the leaves, which may be the reason for reducing the effectiveness of antioxidant enzymes [29] Increasing potassium levels Table (6) in the plant affects plant enzymes and thus leads to an increase in the leaf content of chlorophyll pigment Table (7) which is important in the photosynthesis process, protein and plant hormones (GA3, IAA) Tables (18 and 19) and an increase in the activity of some enzymes that stimulate many physiological processes related to the photosynthesis process [23] In addition, adding organic fertilizers has led to an increase in the concentration of plant hormones auxins and gibberellins in the leaves [30] Then, the vegetative growth rates improved. All these factors could explain the role of organic fertilizers in reducing the concentrations of antioxidant enzymes. .The results also showed that EM1 has a significant role in increasing the percentage of elements in the leaves and their content of carbohydrates, auxin and gibberellin. This may be attributed to the role of microorganisms contained in the EM1 biofertilizer in analyzing the organic matter in

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the growing medium and secreting some compounds such as enzymes, proteins and acids that lead to the release of nutrients and thus increasing the availability of these elements and increasing the efficiency of the roots in absorbing nutrients from the soil. Also, the microorganisms contained in the biofertilizer work to secrete insoluble rock phosphorus salts and convert them into soluble phosphate salts thus increasing the percentage of phosphorus in the leaves, Table (3), as well as the release of trace elements such as iron and zinc from the elements associated with soil minerals [31] and EM1 also contains nitrogen-fixing bacteria that work to increase the nitrogen content of the soil (Table (2)), which plays an important role in the vital processes within the plant due to its participation in the process of photosynthesis and its participation with magnesium in the synthesis of the chlorophyll molecule and increased cell division. EM1 also works to increase the efficiency of the root system in absorbing ready elements from the soil and increasing the decomposition of the organic matter contained in the medium [23] through organisms that have an important role in converting complex organic compounds into simple compounds and raising the efficiency of the roots in absorbing elements, which leads to increased growth of the vegetative system and increased efficiency of the plant's vital processes as a result of the participation of the absorbed elements, especially nitrogen, in increasing photosynthesis, while the percentage of potassium in the leaves increases (Table (3)) or it may be due to the role of the bacteria contained in EM1 in fixing nitrogen and increasing its percentage in the leaves This increase causes the absorption of potassium, which has an effect in stimulating the process of carbon building in the plant, then the transfer of its products to the growth areas and the formation of a strong green group that is reflected in the accumulation of carbohydrates in the leaves (Table 14). Which leads to an increase in the products of these processes such as the manufacture of amino acids, sugars and carbohydrates and their accumulation in the leaves [33] The results also showed the role of nanofertilizer on chemical properties, as the spraying treatment at a rate of 2 mg L-1 significantly excelled the other treatments and gave the highest rate of nitrogen, phosphorus, potassium, zinc, iron, carbohydrates, auxin and gibberellin content in the leaves of the seedlings. This may be attributed to the spraying of zinc at different levels, especially fertilizer manufactured according to nanotechnology, which played a fundamental role in increasing plant growth and increasing the absorption of nutrients. This is due to the effectiveness of nanofertilizers, which may exceed the effectiveness of traditional fertilizers [34]Zinc also plays an important role in regulating the osmotic pressure of cells and opening and closing the stomata, which leads to increased absorption of nutrients and water, which increases the production and accumulation of dry matter. Zinc also plays an important role in activating enzymes that participate in the Krebs cycle, which are important in the respiration process and regulating osmotic potential, as its deficiency leads to a decrease in the rate of photosynthesis. It also plays a role in increasing stomatal conductivity, which supplies the plant with carbon dioxide and water to sustain the photosynthesis process. Absorption of nutrients from the soil leads to increased growth and, as a result, an increase in the dry weight of the vegetative group [35,5.[

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Conclusions

The results showed that organic fertilizers had a significant effect on the studied traits. The treatment with animal and plant wastes (A2) at a rate of 200 g seedling-1 achieved a significant superiority and gave the highest values in leaf content of elements.The results showed that the biofertilizer Em1 had a significant effect in giving the highest rates for most of the studied traits.The study also confirmed that spraying with nano zinc at a rate of 2 g seedling-1 gave a significant superiority for most of the traits of leaf content of nutrients and for fig seedlings of the Black Diyala variety

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