Response of Fig Seedlings of Diyala Black Cultivar to Some Bio-Fertilizers and Foliar Nutrition With Nano-Fertilizer and Amino Acid DRIN

Response of Fig Seedlings of Diyala Black Cultivar to Some Bio-Fertilizers and Foliar Nutrition With Nano-Fertilizer and Amino Acid DRIN

Haneen Abdul Razzaq Jaber[1] and Akram Abd Alkadem Hadi[2]

[1,2]Al-Mussaib Technical College, Al-Furat Al-Awsat Technical University, Iraq.

[1]Email: com.akr@atu.edu.iq

Abstract

This study was conducted in lath house of Mussaib Technical College during the growing season 2020-2021 to know the role of fertilizers and foliar feeding with nano-fertilizer and the amino acid DRIN in some chemical traits and leaf nutrient content of one-year-age fig seedlings.It was implemented as a factorial experiment (4*3*3) with a completely randomized design and with three replications. The experiment included three factors if the first factor included: four ground additions of biofertilizers, namely (BioHealth WSG at a rate of 10 g. pot^{-1} and mycorrhiza 10 g. Pot^{-1} and a mixture of Mycorrhizae and BioHealth WSG at average of 10 g Pot-1) in addition to the control treatment. As for the second factor, it included three levels of foliar feeding with Chelated Nano Fertilizers (KHAZRA), which are 0, 2, 4 g.L^{-1}, while the third factor included three concentrations of foliar nutrition with DRIN, which are 0, 4, 8 ml. L^{-1}. The results confirmed the excelled triple interaction treatment between (ground addition between Mycorrhizae and BioHealth WSG at average of 10 g. pot-^{1} and foliar nutrition with nano-fertilizer at a concentration of 4 g.L^{-1} and amino acid DRIN at a concentration of 8 ml.L^{-1}) significantly on all treatments in the chemical properties (chlorophyll and carbohydrates) and the nutrients content of the leaves (nitrogen, phosphorous, potassium, iron and manganese).

Keywords : Bio-Health, DRIN, Nano-Fertilizer, Amino Acid, Mycorrhizae.

1. Introduction

The fig (*Ficus carica*) belongs to the Moraceae family and is considered one of the oldest plants known to man since the dawn of civilization. It is believed that the original home of the fig is the Arabian Peninsula and from it spread to the rest of the world through the Islamic conquests [1]. Figs are grown for their fruits that are consumed fresh or dry, and the fruits are used in many food industries [2]. The fruits of figs are characterized by a high nutritional value for their content of carbohydrates and proteins in addition to many vitamins and minerals. They are also rich in iron, copper, calcium, vitamins A and C. The milky liquid with leaves, branches and roots possesses medicinal properties [3,4], that the development of fig cultivation requires the availability of strong growing seedlings, so the balanced fertilization of seedlings is one of the important means to achieve, including biofertilizers, to which studies have been directed in recent years to achieve increased production as well as environmental protection and the production of pollution-free crops and foods [5].These fertilizers are preparations that contain live microorganisms, whether bacterial, fungal, or both, and these contain live cells and other latent cells that have the ability to fix nitrogen and dissolve phosphorous and potassium when they are added to the soil. Thus, it works to increase the growth and development of the plant by preparing some of the important and necessary elements for the plant from the soil [6], It also plays an important role in sustainable development through the exchange between types of biological, organic and chemical fertilizers and their impact on the production and quality of plants. It was noted [7], that organic fertilization improved the traits studied in his study on grape vines, a French cultivar , and nano-fertilizers are one of the modern technologies at the present time due to their importance and speed in increasing the readiness and absorption of nutrients. chemical or biological by using nanotechnology to improve its properties and composition, which can enhance crop yield and increase quality standards [8]. It was noted [9], that the foliar nutrition with FOL spray gave a significant increase in all the studied traits of apple seedlings of the ANAN cultivar, and [10], when studying it on orange seedlings when treated with bio-fertilizers and foliar spraying with nano-fertilizer (micro elements) reached a significant increase in the studied traits. compared to the control treatment, The amino acids also play an important role in the process of photosynthesis inside the plant, and the free amino acids activate and develop the vitality of many members of the plant [12]. In her study on fig seedlings, she noticed that foliar spraying with amino acid (Terra-Sorb) led to a significant increase in the studied traits, so

this study came to improve the growth and development of fig seedlings, black cultivar Diyala for some vital fertilizers and foliar feeding with nano fertilizer and amino acid DRIN.

2. Materials and Methods

The research was conducted in the lath house of Al-Musaib Technical College - Al-Furat Al-Awsat Technical University for the period from September 2020 to June 2021, on one-year-old Diyala black cultivar fig seedlings obtained from the Department of Horticulture in Al-Hindi / Holy Karbala province and were planted in plastic bags Which were transferred to plastic pot with a capacity of (8) kg containing river soil and peat moss (1:1). 324 fig seedlings were selected as homogeneous in growth and size as possible and all the service operations were conducted on it. The research was conducted as a factorial experiment (4 * 3 * 3) with a completely randomized design and with three replications. Each replicates includes 108 seedlings with 3 seedlings for each experimental unit and with three factors. Samples were taken from the pot soil to measure some chemical and physical properties of the soil in which the seedlings grow in Table (1), and the factors were as follows:

- The first factor: Four ground additives of bio fertilizers (BioHealthWSG at average of 10 g. Pot^{-1} and Mycorrhiza 10 g. pot^{-1} and a mixture between Mycorrhizal and BioHealthWSG at a average of 10 g. pot^{-1}) in addition to the control treatment
- The second factor is foliar nutrition with nano-fertilizer in three concentrations, 0, 2, 4 g. L^{-1}.
- The third factor is foliar nutrition with amino acid tuberculosis in three concentrations of 0, 4, 8 ml. L^{-1}. All treatments are marked with the symbols of Table (2).

The Mycorrhizal fungus (G. mosseae) vaccine was used 50×10-8 and was added to the pot after placing it near the roots according to the method suggested by (Gerdmann and Nicolson, 1863). As for the Biohealth vaccine, it consists of *Trichoderma hazirianum*, Bacillus subtilis and acid Humic and algae extract were added to the pot soil after placing it near the roots of fig seedlings. As for the process of spraying with nano-fertilizer and amino acid, it was conducted in three dates, where the first spray of nano-fertilizer was tried on 10/4/2021, the second spray on 20/4/2021, and the third spray was conducted on 4/30/2021. As for the amino acid DRIN, it was sprayed on 4/11/2021. For the first and second spray on 21/4/2021. The third spraying was on 5/1/2021, and the control treatment was also sprayed with distilled water only. it used a 2-liter hand sprayer. The spraying process was conducted in the morning until the seedlings were completely wetness. The watering process was conducted for the seedlings one day before the spraying process to increase the efficiency of the plants in absorbing the sprayed substance [13].

2.1 Studied traits

- Chlorophyll content in leaves (SPAD unit):. Leaf chlorophyll content was measured by means of a portable SPAD-502 chlorophyll meter (MIMOLTA CO. LTD. JAPAN) to obtain a rapid estimation of chlorophyll content in leaves simultaneously in the field [14], where three leaves were taken randomly from each plant and the medium was extracted.
- Total carbohydrates (%) in the leaves:. It was estimated according to the method of [15] extraction of soluble sugars using 200 mg of dried and pre-ground seedling leaves for each treatment and placed in test tubes, and 8 cm 3 of ethyl alcohol was added to each sample at a concentration of 80%, then the tubes were placed in a water bath at a temperature of 60 ° C for 30 minutes. minutes with constant stirring. After that, the tubes were placed in a centrifuge, and a Spectrophotometer was used, with a wavelength of (480) nanometers.
- The leaves content of mineral elements (nitrogen - phosphorous - potassium - iron - manganese): Adult leaves were collected randomly from each experimental unit and for each repeater and then washed with distilled water to get rid of dust and suspended impurities and placed in perforated paper bags and then dried in an electric oven)at a temperature of 70 ° C for 48 hours until the weight is stabilized. After drying, the paper forms were ground using an electric grinder, then 0.5 g of each sample was taken and digested by adding sulfuric acid and perchloric acid to obtain colorless extracts available for mineral determination [13], The total nitrogen was estimated using the Microkieldahl device, while the phosphorous was estimated by the ammonium molybdate method, and after the color development, the sample was read in the Spectrophotometer at a wavelength of 620 nm. Potassium was estimated using the Flame photometer according to the recommendations of [16], while the iron and manganese were estimated by the Atomic Absorption Spectrophotometer according to the method [17] and [18].

3. Results

3.1 Chlorophyll content in leaves (SPAD unit)

The results in Table (1) show the biofertilizer treatments excelled on the control treatment in the leaf content of chlorophyll. The mixed biofertilizer treatment (F3) gave the highest significant value of (49.74 SPAD), while the control treatment recorded (F0) ((30.42 SPAD) and the leaf content increased of chlorophyll by adding nano-fertilizer, which gave the treatment (N2) (40.34 SPAD) the highest value compared to the non-adding treatment (N0), which recorded (36.89 SPAD),It also obtained an increase for the same treatment when the amino acid (DRIN) was added, as the treatment (D2) gave (39.16 SPAD) compared to the non-additng treatment (D0), which gave (37.81 SPAD), and the treatment F3N2 was significantly excelled on each other in the bi-interaction between the levels of bio-fertilization and the levels of nano-fertilizer were given (53.01 SPAD) compared to the F0N0 treatment, which was recorded (27.67 SPAD),In the interaction between the levels of biological fertilization and DRIN, treatment F3D2 was significantly excelled by giving it (50.46 SPAD) compared to treatment F0D0, which recorded the lowest average of (29.83 SPAD).The results of the bi-interaction between the levels of nano-fertilization and amino acid showed a clear increase in the content of chlorophyll in leaves, where the treatment (N2D2) was significantly excelled and gave (41.17 SPAD) compared to the control treatment N0D0, which gave the lowest average of (35.65 SPAD),The triple interaction between the factors of the study showed the significantly excelled of the treatment (F3N2D2), which gave (56.12 SPAD) compared to the control treatment F0N0D0, which recorded the lowest value for this trait amounted to (27.31 SPAD).

Table 1. Effect of bio-fertilization with Biohealth WSG, Mycorrhiza and foliar spraying with nano-fertilizer and DRIN, and the interaction between them, the content of leaves from chlorophyll (SPAD) for fig seedlings.

Interaction N x D	Bio fertilization F_3	F_2	F_1	F_0	Amino acid DRIN	Nano fertilizer
35.65	44.22	37.13	33.93	27.31	D0	
36.67	46.56	37.27	34.88	27.97	D1	N0
37.13	38.01	38.01	34.87	28.01	D2	
38.36	38.22	38.22	35.21	29.72	D0	
38.37	39.12	39.12	35.52	30.14	D1	N1
39.10	43.00	43.00	35.97	31.24	D2	
40.06	37.13	37.13	36.15	32.46	D0	
40.74	41.03	41.03	36.54	33.19	D1	N2
41.17	38.08	38.08	36.77	33.71	D2	
The effect of nano fertilizer						
36.89	47.79	37.56	34.56	27.76	N0	interaction
38.62	48.42	40.11	35.27	30.37	N1	Nano × bio
40.34	53.01	39.07	36.15	33.12	N2	F x N
DRIN effect						
37.81	48.80	37.49	35.10	29.83	D0	
38.89	49.78	39.69	35.65	30.43	D1	interaction DRIN × bio D×F
39.16	50.64	39.46	35.54	30.99	D2	
	49.74	38.88	35.43	30.42	The effect of biofertilization	

3.2 Percentage of total carbohydrates in the leaves

The effect of the use of bio-fertilizers was significant in the percentage of total carbohydrates in the leaves, and the results of Table (2) indicate the mixed bio-fertilizer treatment (F3) excelled by giving it the highest value of (40.74%) compared to the control treatment (F0), which gave (28.10%),The addition of nano-fertilizer showed its significant effect in this trait, where the treatment (N2) (36.75%) was excelled on the non-addition treatment (N0), which recorded the lowest value of (33.75%), and there was an increase when adding the amino acid (DRIN) in the percentage of total carbohydrates in the leaves, where treatment (D2) gave the highest value of (35.91%) compared to the control treatment (D0), which recorded the lowest value of (34.55%). In the bi-interaction between the levels of bio-fertilizer and the levels of nano-fertilizer, the treatment F3N2 excelled in the percentage of total carbohydrates in the leaves as it gave (42.02%) compared to the treatment F0N0, which recorded (26.47%), while the interaction between the bio-fertilizer and the levels of amino acid (DRIN) was among the

significantly excelled of the treatment F3N2 which recorded (41.35%) compared to the treatment F0D0, which gave (27.37 %),The treatment of N2D2 was significantly excelled in the bi- interaction between the levels of nano-fertilizer and amino acid (DRIN) by giving it (37.39%) compared to the treatment N0D0, which recorded the lowest value of (32.99%).The results of the triple interaction between the factors of the study showed the superiority of treatment F3N2D2 by giving it the highest percentage of total carbohydrates in the leaves amounted to (43.30%) compared to treatment F0N0D0, which recorded the lowest value for this trait amounted to (25.01%).

Table 2. The effect of biofertilization with Biohealth WSG, Mycorrhizae and foliar spraying with nano-fertilizer and DRIN and the interaction between them on the percentage of total carbohydrates in the leaves of fig seedlings.

Interaction	Bio fertilization				Amino acid DRIN	Nano fertilizer
N x D	F_3	F_2	F_1	F_0		
32.99	39.57	37.25	30.14	25.01	D0	
33.85	39.86	37.86	30.83	26.84	D1	N0
34.42	40.05	38.21	31.88	27.55	D2	
34.41	40.16	37.11	32.20	28.16	D0	
35.05	40.25	38.56	33.01	28.39	D1	N1
35.93	40.70	38.75	35.46	28.81	D2	
36.25	41.30	38.21	36.56	28.93	D0	
36.60	41.47	38.82	36.86	29.26	D1	N2
37.39	43.30	39.26	37.05	29.95	D2	
The effect of nano fertilizer						
33.75	39.83	37.77	30.95	26.47	N0	interaction
35.13	40.37	38.14	33.56	28.45	N1	Nano × bio
36.75	42.02	38.76	36.82	29.38	N2	F x N
DRIN effect						
34.55	40.34	37.52	32.97	27.37	D0	
35.17	40.53	38.41	33.57	28.16	D1	interaction DRIN × bio D×F
35.91	41.35	38.74	34.80	28.77	D2	
	40.74	38.23	33.78	28.10	The effect of bio fertilization	

3.3 Nitrogen content of leaves (%)

The results in Table (3) show the significant increase in the levels of bio-fertilizer, as the treatment of the mixture (F3) and bacterial (B3) was significantly excelled by giving it the highest significant value in the nitrogen content of the leaves, which amounted to (2.11%) compared to the control treatment which recorded (1.09%), and the addition of fertilizer affected nanoparticles in this trait, where the treatment (N2) led to a significant increase of (1.67%) compared to the treatment of no addition (N0), which recorded (1.42%), and the treatment of spraying with amino acid (DRIN) (D2) recorded an increase of (1.59%). While the comparison treatment (D0) recorded the lowest average for the same trait, which amounted to (1.50%). It also obtained a significant increase in the nitrogen content of the leaves, where the bi-interaction between the levels of bio-fertilization and the levels of nano-fertilizer F3N0 recorded the highest value (2.31%), while the treatment F0N0 recorded the lowest value for the same trait amounted to (1.01%), and in the bi-interaction between the levels of bio-fertilization and nano fertilizer, the F3D2 treatment recorded the highest value (2.20%), while the F0D0 treatment recorded the lowest average (1.06 percent).As for the interaction between the levels of nano-fertilizer and foliar spraying with amino acid (DRIN), the same table indicated a clear increase. Treatment N2D2 recorded the highest significant level of (1.74%), while treatment N0D0 gave the lowest value of (1.38%), and in the triple interaction between the study factors The treatment F3N2D2 recorded a significant and clear increase in the nitrogen content of the leaves, reaching the highest increase of (2.64%), while the control treatment F0N0D0 recorded the lowest value of (0.98%).

Table 3. Effect of bio-fertilization with Biohealth WSG and Mycorrhizae and foliar spraying with nano-fertilizer and DRIN and the interaction between them on the nitrogen content of leaves (%) for fig seedlings.

Interaction N x D	Bio fertilization F_3	F_2	F_1	F_0	Amino acid DRIN	Nano fertilizer
1.387	1.870	1.480	1.220	0.980	D0	
1.420	1.940	1.500	1.240	1.000	D1	N0
1.465	1.980	1.570	1.270	1.040	D2	
1.502	2.020	1.610	1.310	1.070	D0	
1.552	2.110	1.670	1.320	1.110	D1	N1
1.577	2.170	1.667	1.340	1.130	D2	
1.622	2.210	1.760	1.380	1.140	D0	
1.667	2.280	1.800	1.410	1.180	D1	N2
1.742	2.460	1.840	1.260	1.210	D2	
The effect of nano fertilizer						
1.424	1.930	1.517	1.243	1.007	N0	interaction
1.544	2.100	1.649	1.323	1.103	N1	Nano × bio
1.677	2.317	1.800	1.417	1.177	N2	F x N
DRIN effect						
1.504	2.033	1.617	1.303	1.063	D0	
1.547	2.110	1.657	1.323	1.097	D1	interaction DRIN × bio D×F
1.595	2.203	1.692	1.357	1.127	D2	
	2.116	1.655	1.328	1.096	The effect of biofertilization	

3.4 The phosphorous content of the leaves (%)

All treatments of the bio-fertilizer outperformed the control treatment (F0) in its effect on the phosphorous content of fig seedlings leaves. The results in Table (6) indicated that the mixed bio-fertilizer treatment (F3) recorded the highest values of (0.63%) while the control treatment (F0) was recorded. The lowest value amounted to (0.34%), and the addition of nano-fertilizer significantly affected this trait, so the treatment (N2) excelled by giving it the highest value amounted to (0.52%) compared to the non-addition treatment (N0), which recorded the lowest value of (0.45%), and the foliar spraying treatment showed In the amino acid (DRIN) of treatment (D2) a clear increase for the same trait amounted to (0.50%), while treatment (D0) recorded the lowest value of (0.47%).The treatment F3N2 was also significantly excelled in the bi-interaction between biofertilization and foliar spraying with nano-fertilizer by giving it the highest rate of (0.70%), while treatment F0N0 gave the lowest value for the same trait amounted to (0.29%), and the treatments of bio-fertilizers with and foliar spraying with amino acid (DRIN) were achieved. Significant superiority as the treatment (F3D2%) gave the highest value (0.66%) compared to treatment F0D0, which recorded the lowest average (0.33%). (0.54%) compared to treatment N0D0, which recorded the value (0.43%) in the phosphorous content of the leaves.The results of the triple interaction between the factors of the study showed the clear significantly excelled in the treatment (F3N2D2), which recorded the highest value by giving it (0.75%) compared to the treatment F0N0D0, which recorded the lowest value for the phosphorous content of the leaves amounted to (0.28%).

3.5 Potassium content of leaves (%)

The results in Table (5) indicate the significantly excelled effect of the biofertilizer treatments on the potassium content of leaves, all of which excelled the control treatment (B1) despite their significant difference between them, where the mixed biofertilizer treatment (F3) gave the highest value of (2.29%)) compared to the control treatment (F0), which recorded the lowest value (1.24%),The addition of nano-fertilizer achieved a significant increase, where the treatment (N2) gave the highest value of (1.83%) compared to the control treatment, which gave (N0), which recorded (1.52%), and the effect of the foliar spraying treatment with amino acid (DRIN) in this trait, where the treatment (D2) was significantly excelled by giving it (1.72%), while the control treatment (D0) gave the lowest rate of (1.61%).While the bi-interaction between the levels of bio-fertilizer and the levels of nano-fertilizer showed the significantly excelled of the F3N2 treatment, which gave the highest potassium content of leaves, reaching (2.61%) compared to the F0N0 treatment, which recorded the value (1.11).The results of the bi-interaction between the levels of bio-fertilization and foliar nutrition with amino acid (DRIN) indicated the treatment F3D2 excelled by giving it the highest values (2.35%) compared to treatment F0D0, which recorded (1.19%), and in the bi-interaction between the levels of nano-fertilizer and foliar nutrition with amino acid (DRIN). The treatment N2D2

significantly excelled by giving it the highest value of (1.89%) compared to the control treatment N0D0, which recorded the lowest potassium content of seedling leaves was (1.74).The triple interaction between the study factors showed the significantly excelled of the treatment F3N2D2, which recorded the value (2.77%) compared to the treatment F0N0D0, which recorded the lowest potassium content of leaves amounted to (1.02%).

Table 4. Effect of bio-fertilization with Biohealth WSG, Mycorrhiza and foliar spraying with nano-fertilizer and DRIN and the interaction between them on the phosphorous content of leaves (%) for fig seedlings.

Interaction N x D	Bio fertilization F_3	F_2	F_1	F_0	Amino acid DRIN	Nano fertilizer
0.435	0.580	0.490	0.390	0.280	D0	
0.452	0.590	0.490	0.440	0.290	D1	N0
0.462	0.600	0.500	0.440	0.310	D2	
0.472	0.600	0.500	0.450	0.340	D0	
0.487	0.620	0.520	0.450	0.360	D1	N1
0.484	0.650	0.530	0.387	0.370	D2	
0.510	0.670	0.530	0.470	0.370	D0	
0.525	0.690	0.540	0.480	0.390	D1	N2
0.546	0.753	0.550	0.490	0.390	D2	
The effect of nano fertilizer						
0.450	0.590	0.493	0.423	0.293	N0	interaction
0.481	0.623	0.517	0.429	0.357	N1	Nano × bio
0.527	0.704	0.540	0.480	0.383	N2	F x N
DRIN effect						
0.472	0.617	0.507	0.437	0.330	D0	
0.488	0.633	0.517	0.457	0.347	D1	interaction DRIN × bio D×F
0.497	0.668	0.527	0.439	0.357	D2	
	0.639	0.517	0.444	0.344	The effect of biofertilization	

Table 5. Effect of bio-fertilization with Biohealth WSG, Mycorrhizae and foliar spraying with nano-fertilizer and DRIN, and the interaction between them on potassium content (%) of fig seedlings in leaves.

Interaction N x D	Bio fertilization F_3	F_2	F_1	F_0	Amino acid DRIN	Nano fertilizer
1.470	1.860	1.590	1.410	1.020	D0	
1.535	1.980	1.620	1.430	1.110	D1	N0
1.567	1.980	1.650	1.440	1.200	D2	
1.602	2.050	1.670	1.470	1.220	D0	
1.635	2.110	1.680	1.480	1.270	D1	N1
1.715	2.320	1.740	1.490	1.310	D2	
1.762	2.430	1.750	1.520	1.350	D0	
1.840	2.650	1.790	1.560	1.360	D1	N2
1.895	2.770	1.840	1.580	1.390	D2	
The effect of nano fertilizer						
1.524	1.940	1.620	1.427	1.110	N0	interaction
1.651	2.160	1.697	1.480	1.267	N1	Nano × bio
1.832	2.617	1.793	1.553	1.367	N2	F x N
DRIN effect						
1.612	2.113	1.670	1.467	1.197	D0	
1.670	2.247	1.697	1.490	1.247	D1	interaction DRIN × bio D×F
1.726	2.357	1.743	1.503	1.300	D2	
	2.239	1.703	1.487	1.248	The effect of biofertilization	

3.6 Iron content of leaves (mg.kg^{-1})

Table (6) shows the significant effect of bio-fertilizer treatments on the iron content of leaves for fig seedlings, where the mixed bio-fertilizer treatment (F3) excelled by giving it the highest value of (153.26 mg.kg^{-1}) compared to the control treatment (F0), which recorded the lowest value of 153.26 mg.kg^{-1}. (91.33 mg.kg^{-1}), and the treatment of adding nano-fertilizer (N2) was significantly excelled by giving it (127.51 mg.kg^{-1}) compared to the non-addition treatment (N0), which gave (114.09 mg.kg^{-1}), and the addition of amino acid was affected (DRIN) in this trait, where treatment (D2) excelled by giving it an increase of (123.91 mg.kg^{-1}) compared to treatment (D0), which recorded the lowest value of (118.44 mg.kg^{-1}) In the bi-interaction between the levels of biofertilizer and nano-fertilizer, the treatment F3N2 was significantly excelled by giving it (159.51 mg.kg^{-1}) compared to the treatment F0N0, which recorded the lowest value of (82.63 mg.kg^{-1}).The interaction between the levels of DRIN and bio fertilizers in the iron content of leaves was shown. The treatment F3D2 was significantly excelled by registering the highest value of (156.14 mg.kg^{-1}) compared to the treatment F3D0 which gave (87.32 mg.kg^{-1}), and the results indicated The bi-interaction between the levels of the nano-fertilizer and the amino acid (DRIN) to the significantly excelled of the treatment N2D2, which gave (129.96 mg.kg^{-1}) compared to the treatment N0D0, which recorded the lowest value for this trait was (109.96 mg.kg^{-1}). The treatment F3N2D2 excelled in the triple interaction between the study factors by giving it (163.26 mg.kg^{-1}) compared to the treatment F0N0D0, which recorded the lowest value in the iron content of leaves amounted to (74.10 mg.kg^{-1}).

Table 6. Effect of bio-fertilization with Biohealth WSG and mycorrhizae and foliar spraying with nano-fertilizer and DRIN and the interaction between them on iron content of leaves (mg.kg^{-1}) for fig seedlings.

Interaction N x D	Bio fertilization F_3	F_2	F_1	F_0	Amino acid DRIN	Nano fertilizer
109.96	143.44	119.19	103.10	74.10	D0	
114.41	146.27	123.46	105.47	82.44	D1	N0
117.91	148.17	125.50	106.60	91.36	D2	
120.24	152.50	127.90	107.80	92.76	D0	
121.51	153.47	130.80	108.26	93.50	D1	N1
123.87	157.00	131.67	112.44	94.38	D2	
125.13	157.00	133.10	115.30	95.10	D0	
`127.45	158.26	137.80	115.45	98.30	D1	N2
129.96	163.26	140.00	116.57	100.01	D2	
The effect of nano fertilizer						
114.09	145.96	122.72	105.06	82.63	N0	interaction
121.87	154.32	130.12	109.50	93.55	N1	Nano × bio
127.51	159.51	136.97	115.77	97.80	N2	F x N
DRIN effect						
118.44	150.98	126.73	108.73	87.32	D0	
121.12	152.67	130.69	109.73	91.41	D1	interaction DRIN × bio D×F
123.91	156.14	132.39	111.87	95.25	D2	
	153.26	129.94	110.11	91.33	The effect of biofertilization	

3.7 Manganese content of leaves (mg.kg^{-1})

Table (7) shows the significant effect of biofertilizer treatments on the manganese content of leaves, where the mixed biofertilizer (F3) was excelled to (53.22 mg.kg-1) compared to the control treatment (F0), which recorded (21.15 mg.kg-1). The treatment of adding nano-fertilizer (N2) was significantly excelled by giving it (42.46%) compared to the treatment of no addition (N0), which gave the lowest value of (34.25 mg. kg-1). The addition of the amino acid (DRIN) affected this trait, as treatment (D2) gave a clear increase in the manganese content of leaves by giving it (39.43 mg. kg-1) compared to the control treatment (D0), which recorded the lowest value (37.19 mg. kg-1). In the bi-interaction between the levels of biofertilizer and the levels of nano-fertilizer, the treatment F3N2 was significantly excelled by giving it the highest value of (57.95 mg.kg-1) compared to the treatment F0N0 which recorded (15.70 mg.kg-1), and the interaction between the levels of histidine (DRIN) showed. The biofertilizer was significantly excelled on the treatment F3N2 by giving the highest value in the leaves content of manganese amounted to (54.09 mg.kg-1) compared to the treatment F0N0, which gave the lowest value amounted to (19.92 mg.kg^{-1}). The amino acid (DRIN) showed the significantly excelled of treatment N2D2, which gave (43.88 mg.kg^{-1})

compared to treatment N0D0, which recorded the lowest value for this trait amounted to (33.59 mg.kg^{-1}).The treatment F3N2D2 excelled in the triple interaction between the study factors in the manganese content of leaves by giving it (59.45 mg.kg^{-1}) compared to the treatment F0N0D0, which recorded the lowest value of (14.85 mg.kg^{-1}).

Table 7. Effect of bio-fertilization with Biohealth WSG, Mycorrhiza and foliar spraying with nano-fertilizer and DRIN, and the interaction between them on the manganese content of leaves (mg.kg^{-1}) for fig seedlings.

Interaction N x D	Bio fertilization F_3	F_2	F_1	F_0	Amino acid DRIN	Nano fertilizer
33.59	48.82	41.25	29.43	14.85	D0	
34.20	49.11	41.72	30.49	15.47	D1	N0
34.96	49.36	42.23	31.45	16.78	D2	
36.93	51.16	43.69	32.54	20.31	D0	
38.49	53.24	45.10	33.91	21.70	D1	N1
39.47	53.45	45.37	35.41	23.65	D2	
14.05	56.28	47.63	35.70	24.59	D0	
42.46	58.12	47.65	38.47	25.59	D1	N2
43.88	59.45	48.56	40.09	27.41	D2	
The effect of nano fertilizer						
34.25	49.10	41.73	30.46	15.70	N0	interaction
38.29	52.62	44.72	33.95	21.89	N1	Nano × bio
42.46	97.95	47.95	38.09	25.86	N2	F x N
DRIN effect						
37.19	52.09	44.13	32.56	19.92	D0	
38.38	53.49	44.82	34.29	20.92	D1	interaction DRIN × bio D×F
39.43	54.09	45.39	35.65	22.61	D2	
	53.22	44.80	34.17	21.15	The effect of biofertilization	

4. Discussion

The results in Tables (1-7) showed the significant increase in the chlorophyll content of the leaves, the percentage of total carbohydrates and the nutrients content of the leaves (nitrogen - phosphorous - potassium - iron and manganese) as a result of the addition of biofertilizers. The reason for the increase may be due to the role of Biohealth WSG and mycorrhiza fungi. Which have been added individually or collectively and the great role that these organisms play in improving the symbiotic relationship between the plant and the soil and contribute effectively to increasing the absorption of nutrients from the growth medium and also contribute, and these fungi and bacteria when infecting the roots of the plant, they spread fungal hyphae These micro-organisms work to improve the physical and chemical properties of the soil as a result of the important role they play as soil conditioners in the root-infested areas. It also increases the cation exchange capacity, which enhances the activity of other microorganisms present in the soil [20], which improved The increase in the growth and development of fig seedlings in the previous tables as a result of the addition of nano-fertilizer may be due to the fact that these fertilizers provide a larger surface area for the various metabolic reactions in the plant and the ease of penetration of these pores into the walls of the plant Plant cells, which facilitates access to vascular bundles [21], and this fertilizer contains important nutrients that contribute to activating enzymes and raising the efficiency of the photosynthesis process. It also stimulates the process of opening and closing stomata, which increases the process of transpiration and thus increases the nutrients absorbed from Amidst the growth by the roots [22], and consequently an increase in the growth and development of seedlings that were treated with this treatment. As for the spraying treatment with amino acids, it led to an increase in the aforementioned characteristics, and the reason may be due to its great role in stimulating physiological and biochemical processes and its role in building proteins and making carbohydrates By building chlorophyll and stimulating the process of photosynthesis and thus the accumulation of processed nutrients, and these acids contribute greatly to our E and encouraging the work of many enzymes, enzymatic conjugates, and purine and pyrimidin bases [23]. As for the reason for the superiority of the interaction factors, the reason may be due to the interaction of these compounds with biofertilizers, which contributed significantly to the absorption and accumulation of nutrients in the plant and thus reflected positively in improving the growth and development of these seedlings. .

Conclusions

We conclude from the study that the triple interaction treatment was significantly excelled on all treatments between (ground addition between Mycorrhizae and BioHealth WSG, foliar spraying with nano-fertilizer at a concentration of 4 $g.L^{-1}$ and foliar spraying with amino acid DRIN at a concentration of 8 $ml.L^{-1}$) in all vegetative and root traits studied.

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