The Effect Of Soil Treatment With Cow Manure Compost And Foliar Magnesium On Plant Growth Of Black Diyala Fig Ficus Carica L. Seedlings

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KEYWORDS
Figs, foliar fertilization, organic acids, micro-nutrients, saplings.

ABSTRACT
The research was conducted at the research station affiliated with the Faculty of Agriculture / University of Kufa in the university city in the Najaf Governorate for the period from 1 March to 1 December 2023 to study the effect of organic fertilization with cow manure compost and foliar spraying with magnesium and their interactions on some vegetative traits of black Diyala fig seedlings. The foliar magnesium was used at four concentrations (0, 0.5, 1 or 1.5) gm L-1, and the ground addition of organic fertilizer (cow manure) was also applied at four levels (0, 5, 10 or 15) g pot-1, and their interactions. The results showed that black Diyala fig seedlings treated with cow manure compost recorded significant effect on the studied traits, as cow manure compost at 15 g pot-1 resulted in the highest increase of seedlings height 21.37 cm, stem diameter 2.07 mm, number of branches 3.30 seedling branch-1, number Leaves 10.03 leaf plant -1, and leaf area 2448.25 cm2 seedling-1. Spraying fig seedlings of the Black Diyala variety with magnesium at a concentration of 1.5 gm l-1 excelled in the amount of increase in seedling height 15.98 cm, stem diameter 1.82 mm, number of branches 3.23 seedling branch-1, and number of leaves. 10.36 plant leaves-1, average leaf area is 1899.50 cm2 seedling-1. However, best results were recorded in the interaction of foliar magnesium at 1.5 gm L-1 and organic fertilizer at 15 g pot-1 with significantly the highest increase in plant height 25.56 cm and stem diameter 2.28 mm, the number of branches is 5.28 branches, seedling-1, the number of leaves is 15.00 leaves-1, the average leaf area is 3030.00 cm2, seedling-1.

1. Introduction

The mulberry family Moraceae includes the figs tree (Ficus carica L.). The English word Fig comes from the Indian term Feg, whereas the name Carica is given in honour of a western Anatolian province known for its cultivation and production. The fig tree is thought to have originated on the Arabian Peninsula; today, you can still find it growing wild in forests there. However, following the Islamic conquests of many areas, Muslims started growing the tree in Mediterranean countries like Greece, Portugal, Spain, and southern France (2010).

When it comes to fruit trees, foliar fertilisation is a must-have method. It helps produce robust plants by delivering macro- and micronutrients in an absorbable form through the leaves, rather than relying on soil, which can be unsuitable for some soil types. However, fruit trees' vegetative traits and yields may be enhanced by spraying fertiliser solutions that include micro- and macro-elements (Spinelli et al., 2010).

Organic fertilizer is one of the forms of using organic fertilizers because it contains many nutrients and beneficial microorganisms and works to stimulate plant growth (Quarles, 2001). Among these fertilizers is cow manure, which some studies have indicated is superior in giving growth and good yields to plants compared to other manure fertilizers. (Ghorbani et al., 2008 and Al-Amiri et al., 2014).

Among the many essential elements, magnesium requires comparatively large amounts from plants. This is because it plays a pivotal role in the synthesis of chlorophyll, a molecule essential to photosynthesis; in fact, chlorophyll accounts for as much as seven percent of magnesium in plants (IPIN, 2007). The lack of magnesium in plants can be a determinant of plant productivity, especially in intensive agricultural systems, as well as in lands fertilized with nitrogen, phosphorus, and potassium (NPK) (Yazici and Cakmak, 2010). Therefore, the study aimed to evaluate the effect of adding organic fertilizers (cow manure) and/or foliar spray with magnesium on improving the vegetative and root growth characteristics of black Diyala fig seedlings. foliar spraying with magnesium in improving the growth characteristics of fig seedlings. And determining the best fertilizer combination of these factors for best results.

2. Methodology

Experiment site

The research was carried out at the Agricultural Research Station of the College of Agriculture, University of Kufa, in the university city, for the period from 3/1/2023 to 12/1/2023 to study the effect of organic fertilization with decomposed manure and foliar spraying with magnesium on some vegetative characteristics of fig seedlings, the Diyala black variety, and the nutritional elements content of its tissues.

Preparing fig seedlings

The study station was equipped with plastic bags with a capacity of 3.5 kg and a height of 25 cm. Fig seedlings were chosen at 6 months of age when they were almost identical in size and height. A total of 192 fig seedlings were transplanted to plastic pots of 10 Kg soil 15 days before to the experiment's date and maintained under a saran cover. In order to ascertain a number of its physical and chemical properties, soil samples were collected, mixed uniformly, and analysed (Page et al., 1982; Black, 1965) (Table1). During the course of the trial, the seedlings were consistently subjected to all of the crop service activities, including fertilisation, watering, hoeing, and pest control.

Experiment factors

1- Magnesium fertilizer

Magnesium fertilizer powder containing MgO 21.80% and Amino-L 5% was obtained from a certified agricultural shop, where 4 concentrations were used (0, 0.5, 1, and 1.5) g litre^{-1} to be sprayed on the plant shoot using a 2 litres capacity sprayer in equal monthly applications.

2- Organic fertilizer (cow manure compost)

Animal manure (cow manure composted for 120 days) was added at four levels (0,5^{-1}0^{-1}5 gm pot^{-1}) which was also subjected to content analysis (Table 2).

Table1. Some physical and chemical characteristics of the soil before conducting the experiment

Characters	**Value**	**Unit**
EC	3.5	DS/M
pH	7.4	-
Available Nitrogen	63	%
Available Phosphorus	12.9	%
Available potassium	108	%
Magnesium	14.2	µmol.mol.L^{-1}
Organic matter	2.55	g.kg^{-1}
Characters	Value	Unit
Clay	4.8	gram soil.pot^{-1}
Silt	24	gram soil.pot^{-1}
Sand	71.8	gram soil.pot^{-1}
Texture	Sandy mixture	-

Table 2. Some physical and chemical properties of organic fertilizer (cow manure compost)

Characters	**Value**	**Unit**
EC	6.7	DS/M
pH	6.8	-
Available nitrogen	6.3	%
Available Phosphorus	12.9	%
Available potassium	10.8	%
Magnesium	14.2	µmol.mol.L^{-1}

Studied characteristics

The height of the seedling (cm)

Prior to the commencement of the experiment, the seedlings' height was measured using a metric tape, starting from the soil's surface and ending at the plant's top stem. When it came time to record the findings at the conclusion of the experiment, the procedure was repeated. The rate of growth in seedling height was determined for each experimental unit by subtracting the two values (final - beginning).

Stem diameter (mm)

At the start and end of the experiment, the Vernia foot was used to measure the diameter of the sapling stem at a height of 5 cm. The rate of increase in stem diameter was found by removing the two numbers (final - initial). This was done for each experimental unit.

The number of branches (branch seedling $^{-1}$)

We kept track of how many branches were on each seedling's main stem at the beginning and end of the experiment. To find the rate of growth in the number of branches, we took the difference between the two numbers (final - beginning). Then, we got this rate for each unit of the experiment.

The number of leaves (leaf seedling $^{-1}$)

We set the rate for each experimental unit and the number of leaves for each plant at the start of the experiment. After the experiment was over, the steps were done again to write down what was found. For each study unit, the rate of growth in the number of leaves was found by taking the difference between the two numbers.

Total leaf area (cm^2 seedlings^{-1})

Finding the seedling's leaf area after the experiment was over was as easy as adding up the areas of all the leaves. Before finding the average leaf area, full-width leaves from different parts of each trial unit were scanned electronically using the Image J software on a computer. We found the mean leaf area and wrote it down. With the average leaf area and the number of leaves on each seedling at the end of the trial, we were able to use the following equation to find the leaf area of one plant: (Al-Zaidi, 2016) and (Sadik et al., 2011)

Leaf area of seedlings = number of leaves per seedling x average area of one leaf (cm^2).

Statistical analysis

In this factorial experiment, which followed the Randomised Complete Block Design (RCBD) protocol (Al-Rawi and Khalfallah, 2000), 192 seedlings were utilised. The first factor was a mixture of four different concentrations of magnesium (0-0.5^{-1-1}.5 g L^{-1}) and organic fertiliser (manure) at four different levels (0-5^{-1}0^{-1}5 g pot^{-1}). The treatments were randomly distributed among three replicates, each with sixteen experimental units. Each unit consisted of four seedlings, for a total of 192 seedlings. Two sprays were used in the spring and two in the autumn to administer the therapies. The GenStat, a computing statistical programme (VSN International 2009) was used to analyse the data after the experiment ended on 12/1/2023. Averages were compared using the L.S.D. test ($P \leq 0.05$).

3. Results and discussion

Plant height (cm)

In Table 4^{-1}, we can see that organic fertilisation has a big effect on how fast fig plants grow tall. The results show that the rate of height gain was highest at 15 g pot^{-1} and lowest at 7.70 cm when treated with Comparison. This shows that organic fertilisation has a big effect on how tall fig plants get.

In the same table, we can see that the rate of height increase of fig seedlings was significantly affected by spraying magnesium at a concentration of 1.5 gm L^{-1}. The comparison treatment had the lowest rate of growth at 11.27 cm, while the magnesium spray treatment significantly outperformed it with a rate of 15.98 cm.

The same table also shows that the interaction between organic fertilisation and magnesium spraying significantly affected the rate of height increase in seedlings. For example, fig seedlings treated with 15 gm sandana^{-1} organic fertilisation and 1.5 gm l^{-1} magnesium sprayed had the highest rate of height increase, reaching 25.56 cm, compared to the comparison treatment that had an average height of 6.50 cm.

Table 1. The effect of organic fertilization, magnesium spraying, and their interaction on the rate of increase in plant height (cm)

Organic fertilization (g.pot^{-1})	Mg (mg.L^{-1})				Average
	0	0.5	1	1.5	
0	6.50	6.76	8.49	9.05	7.70
5	7.73	8.83	10.45	12.47	9.87
10	13.41	14.54	15.81	16.82	15.15
15	17.44	19.28	23.21	25.56	21.37
Average	11.27	12.35	14.49	15.98	
L.S.D (0.05)	Organic fertilization = 0.858		Mg = 0.858	Interaction = 1.716	

Stem diameter (mm)

Table 4-2 shows that organic fertilisation significantly affects the amount of stem diameter increase. The treatment with 15 g pot^{-1} of organic fertiliser increased the average stem diameter by 2.07 mm, which is significantly better than the lowest increase of 1.25 mm. When addressing comparison.

Spraying magnesium at a concentration of 1.5 gm L^{-1} considerably outperformed the other treatments, giving the highest amount of increase in stem diameter of 1.82 mm compared to the lowest rate of increase of 1.47 mm in the control treatment, as shown in the same table. This suggests that spraying magnesium has a significant effect on the rate of increase in stem diameter.

For fig seedlings treated with a mixture of organic fertiliser at a concentration of 15 gm sandana^{-1} and magnesium spray at a concentration of 15 gm l^{-1}, the highest rate of stem diameter increase was 2.28 mm, as shown in the same table as other results. This was in contrast to the plant's stem diameter increased by the least amount (1.25 mm) in the comparative treatment.

Table 2. The effect of organic fertilization, magnesium spraying, and their interaction on the rate of increase in stem diameter (mm)

Organic fertilization (g.pot^{-1})	Mg (mg.L^{-1})				Average
	0	0.5	1	1.5	
0	1.25	1.25	1.26	1.39	1.29
5	1.27	1.31	1.66	1.78	1.50
10	1.55	1.59	1.67	1.83	1.66
15	1.82	2.08	2.09	2.28	2.07
Average	1.47	1.56	1.67	1.82	
L.S.D (0.05)	Organic fertilization = 0.102		Mg = 0.102	Interaction = 0.204	

Number of branches (branch seedling^{-1})

Table 4-3 shows that when fig plants are fertilised with organic fertiliser, the rates at which the branches grow are very different. For instance, the treatment that added 15 grams of sandana^{-1} fertiliser had the fastest branch growth, hitting 3.30 baby branches per day. The treatment with the slowest growth rate was the least useful. The saplings got 2.42 stems per plant after being sprayed with pure water.

When you spray fig seedlings with 1.5 gm liter^{-1} of magnesium, the number of branches grew at the fastest rate, equal to 3.23 seedling branches^{-1}. This is shown in the same table as the lowest rate of increase in the lowest increase in when plants were sprayed with purified water, each one grew an average of 2.18 branches.

As shown in the same table, the rate of growth in the number of branches for fig seedlings was most affected by how the two experimental factors interacted with each other. Specifically, the treatment that led to the fastest rate of growth was the one that mixed spraying magnesium at a concentration of 1.5 gm l^{-1} with organic fertiliser at a concentration of 15 gm pot^{-1}. It got to 5.28 seedling $branches^{-1}$, which is more than the normal number of branches, which was 2.20 seedling $branches^{-1}$.

Table 3. The effect of organic fertilization and magnesium spraying and their interaction on the rate of increase in the number of branches (seedling branch - 1)

Organic fertilization ($g.pot^{-1}$)	Mg ($mg.L^{-1}$)				Average
	0	0.5	1	1.5	
0	2.20	2.20	2.79	2.49	2.42
5	2.27	2.79	2.42	2.64	2.53
10	2.05	2.57	3.08	2.49	2.55
15	2.20	2.57	3.15	5.28	3.30
Average	2.18	2.53	2.86	3.23	
L.S.D (0.05)	Organic fertilization = 0.281		Mg = 0.281		Interaction = 0.562

Number of leaves (leaf seedling $^{-1}$)

Table 4-4 shows that adding organic fertiliser had a significant effect on increasing the rate of leaf growth. Specifically, the organic fertilisation treatment with a concentration of 15 g pot^{-1} significantly outperformed the comparison treatment, leading to a rate of 10.03 seedling $leaves^{-1}$, the highest rate of leaf growth. The result was the lowest increase in leaf number, 7.07 seedling $leaf^{-1}$.

According to the same table, spraying fig seedlings with magnesium at a concentration of 1.5 gm l^{-1} resulted in a significantly higher average number of leaves (10.36 seedling $leaves^{-1}$) than spraying the seedlings with distilled water, which produced fewer leaves. This suggests that spraying magnesium had a substantial impact on increasing the average number of leaves of fig seedlings. On average, there were 7.04 seedling leaves per plant.

Treatments involving the addition of organic fertiliser at a concentration of 15 gm pot^{-1} and spraying magnesium at a concentration of 1.5 gm l^{-1} produced the highest average number of leaves, reaching 15.00 seedling $leaf^{-1}$, and performed better than all treatments. This suggests that the studied trait was significantly affected by the interaction between the two experimental factors. In contrast to the control group, this had an average of 5.26 seedling leaves per plant.

Table 4. The effect of organic fertilization, magnesium spraying, and their interaction on the rate of increase in the number of leaves (seedling leaf - 1)

Organic fertilization ($g.pot^{-1}$)	Mg ($mg.L^{-1}$)				Average
	0	0.5	1	1.5	
0	5.26	7.25	7.25	8.55	7.07
5	7.50	7.63	8.58	8.83	8.13
10	7.63	7.66	8.56	9.06	8.23
15	7.76	8.44	8.94	15.00	10.03
Average	7.04	7.74	8.33	10.36	
L.S.D (0.05)	Organic fertilization = 0.534		Mg = 0.534		Interaction = 1.068

Average leaf area ($cm^2.seedling^{-1}$)

Table 4-5 shows that at a concentration of 15 gm pot^{-1}, the organic fertilisation treatment gave the greatest rate of increase in leaf area, amounting to 2448.25 cm^2, compared to the other treatments, demonstrating that organic fertilisation significantly increases the average leaf area of fig seedlings young plant. There was a considerable improvement in the rate of leaf growth (1129.58 cm^2) as compared to the distilled water spray treatment young plant.

The results in the same table showed that spraying fig seedlings with magnesium had a notable impact on increasing their average leaf area. Specifically, the treatment with 1.5 gm l^{-1} of magnesium spray produced the highest average leaf area of 1899.50 cm^2, which was significantly higher than the other treatments. Comparison of seedling^{-1} to the average leaf area was the lowest at 1263.25 cm^2 when treated with distilled water spray young plant.

Because the organic fertilisation treatment with a concentration of 15 gm sandana^{-1} and the spraying of magnesium at a concentration of 1.5 gm l^{-1} produced the highest average leaf area of fig seedlings, amounting to 3030.00 cm^2, the results in the same table show that the interaction between the two experimental factors has a significant impact. Seedling^{-1}, in contrast to the comparator treatment's lowest average leaf area of 758.33 cm^2.seedling^{-1}.

Table 5. The effect of organic fertilization, magnesium spraying, and their interaction on average leaf area (cm^2.seedling^{-1})

Organic fertilization (g.pot^{-1})	Mg (mg.L^{-1})				Average
	0	0.5	1	1.5	
0	758.33	1165.00	1268.00	1327.00	1129.58
5	1024.67	1136.33	1344.00	1499.33	1251.08
10	1535.67	1625.33	1649.00	1741.67	1637.92
15	1734.33	2163.00	2865.67	3030.00	2448.25
Average	1263.25	1522.42	1781.67	1899.50	
L.S.D (0.05)	Organic fertilization = 116.6		Mg = 116.6	Interaction = 233.2	

The reason of increasing in indicators of vegetative growth of fig seedlings can be explained due to the role of organic manures in increasing the proportion of elements and the role of these elements, whether by entering into its composition or by stimulating and activating the vital processes related to their production in the cell, and then increasing the processes. vitality (Agbede et al., 2008). This agrees with the results of Al-Zuhairi (2017) on citrus fruits. This may be due to the fact that organic matter is a source of the major and minor elements necessary for plant growth and provides the plant with appropriate quantities of these elements, which provides the plant with its necessary needs. The decomposition of organic fertilizers in the soil also leads to the formation of organic acids such as humic acid, fulvic acid, and natural chelates that contribute In the release of potassium and other elements from the soil elements in the area of the root system, and this release of elements increases with the increase in the release of organic acids produced by decomposing organic materials. The results obtained from the study indicate that their increase in these elements coincided with an increase in levels of organic manure (cow manure), which indicates an effect of these levels.

This is consistent with the findings of Abdel-Moniem et al. (2008) that organic manure is a mixture of major and minor elements essential for growth such as nitrogen, phosphorus, potassium, iron, and others, and increasing their concentration to a certain extent leads to increased absorption by the plant, which increases the content of the leaves (Osman et al., 2010).

The increase in the soil content of ready-made elements is due to lowering the pH of the soil due to the organic acids present in the organic fertilizer. It is also due to its role as a chelating substance that prevents the leaching of nutrients from the soil, thus increasing its preparation for the plant (Karmegam and Daliel, 2008), in addition to the fact that organic acids improve the physical, chemical and biological properties. To the soil, it reduces the problems and damages of excess salinity and alkalinity, and then increases the spread capacity of the plant's root system, its ability to absorb, and the plant's content of nutrients, carbohydrates, and protein (Blackett, 2014). The results agree with Al-Taie (2014) regarding orange.

Spraying magnesium had a significant effect in improving most of the traits of fig seedlings. We review the most important reasons and features of magnesium in the plant that led to improving most of the traits. It has been found that magnesium is one of the major essential nutrients in plant nutrition due to its effective role in many vital processes in the plant, such as the process of photosynthesis, as it is included in the composition of the chlorophyll molecule, and magnesium is the mineral key to it, as each chlorophyll molecule contains one atom of magnesium, which constitutes what It is approximately 2.7% of the chlorophyll molecule, and this percentage represents 15-30% of the total magnesium in the plant. Most magnesium is found in chloroplast (Merhaut, 2007). Magnesium also has a role in activating all the enzymes responsible for the process of photophosphorylation (Phosphorylation), as it forms a bridge between the phosphate that returns to ATP and ADP and the enzyme molecule. Magnesium is also necessary for the activity of the main enzymes such as: phosphonyl pyruvate carboxylase and Ribulose 1-5 Bisphosphate Carboxylase, the latter of which is the most important enzyme in the availability of protein in plant leaves, as it stimulates the assimilation of atmospheric carbon dioxide in the Calvin cycle. It also helps in the stability of ribosomes and is therefore an important factor for these compounds that are related to protein metabolism (Barker and Pilbeam, 2015). In addition, magnesium has a role in activating several enzymes and coenzymes that participate in the process of catabolism of carbohydrates through the glycolysis process that ends with the formation of pyruvic acid or in the Krebs cycle for the final respiratory process that takes place in the mitochondria. Among these enzymes are They are Enolase, Carboxylase, Pyruvic phosphokinase, and the coenzyme Acetyl CoA (Karley and White, 2009). Magnesium is also necessary for what is known as the sodium pump (K-Na pump), which works to introduce potassium and expel sodium from the plant cells to the outside. It also plays an important role in converting mineral phosphorus into organic phosphorus within the plant and is considered a transporter of phosphorus within the plant (Abu Dahi and Al-Younis, 1988 and Al-Naimi, 1999).

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