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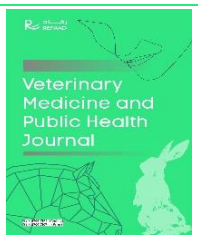

Effect of Foliar Spraying of Magnesium and Manganese on Growth and Productivity Vocabulary of Bean Plants (*Vicia faba* L.)

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Abstract:

Objectives: Due to the large number of problems with the readiness of some mineral elements in most of the lands of Iraq due to several factors that limit their movement and readiness, which has a negative impact on the plants, therefore, researchers have turned to using modern methods and methods for the purpose of adopting them in supplying plants with the necessary nutrients for continued growth and achieving productivity. One of these methods is the foliar feeding method, in order to study the effect of foliar spraying of the elements magnesium and manganese on the growth and productivity of the bean plant (Luz De Otono).

Methods: A field experiment was implemented during the 2022-2023 season in Al-Muthanna Governorate - Al-Majd district, which is (7 km) north of the governorate, where magnesium was sprayed at four concentrations: 0, 40, 80 and 120 mg Mg liter-1) of manganese in three concentrations (0, 20 and 40 mg Mn liter-1). The experiment was applied using a completely randomized block design (R.C.B.D).

Results: The results showed that spraying magnesium at the highest concentration of 120 mg Mg l-1 led to a significant effect on plant height and biological yield, with rates of increases reaching 5.95% and 16.84%, respectively, compared to the comparison treatment, while spraying at a concentration of 80 mg Mg l-1 had a significant effect and gave the highest rate of height. Pod and total seed yield, with averages of 20.37 cm and 2.53 tons ha-1 compared to the comparison treatment, which gave the lowest averages of 19.36 cm and 1.97 tons ha-1 for the traits respectively It was noted from the results that increasing the manganese concentration to 40 mg Mn liter-1 led to a significant increase in plant height, biological yield, and harvest index, as it gave averages of 60.08 cm, 6.62 tons ha-1, and 40.10% for the traits, respectively, compared to the no-spraying treatment. The interaction between magnesium and manganese had a significant effect on plant height, as the combination of the highest concentration of magnesium with manganese (Mg3 x Mn2) gave average of 63.08 cm.

Conclusions: Spraying with the highest concentration of magnesium resulted in a significant improvement in physiological traits.

Keywords: *magnesium; manganese; Faba bean.*

1 Introduction

Faba bean (Vicia faba L.) is a winter crop from the legume family Fabaceae. Their importance is due to their important effect in fixing atmospheric nitrogen, which contributes to improving soil properties and also interferes with the agricultural effects of crops, especially in desolate areas (Abbas, 2012). The cultivated area of beans in Iraq reached 125 thousand hectares, with a productivity of 4,000 kg ha-1 (Central Bureau of Statistics, 2016).Due to the many problems with the readiness of some mineral elements in most of the lands of Iraq due to several factors that limit their movement and readiness, including the high degree of soil interaction or competition and interference between ions, which led to a decrease in the activities of positive and negative ions that benefit the growing plant, which negatively affected the plant, therefore researchers turned to Using modern methods and methods for the purpose of adopting them in supplying plants with the necessary nutrients for continued growth and achieving productivity, and one of these methods is the foliar feeding method (Al-Janabi, 2016).

Foliar feeding is one of the most efficient, good and economical methods for treating nutrient deficiencies. Its efficiency increases by 8-20 times compared to ground fertilization, especially with microelements (Wittner, 1999). Magnesium is important in the synthesis of chlorophyll, as it is the center of the chlorophyll molecule, and it has a major effect in many physiological processes of the plant, as it participates in the formation of the bark, affects the manufacture of proteins and the formation of chromosomes, and is important in activating many enzymes such as (AMP Pyrophosphorylase, Hexokinase, and Glucokinase) (Verbruggen and Hermans, 2013 and Qader, 2019). Thalooth and others (2006) found in their experiment conducted in Egypt on the mung crop, in which two concentrations were used (0 and 50 mg Mg l-1), that spraying magnesium at a concentration of 50 mg Mg l-1 had a significant effect and gave the highest averages in plant height, number of branches, and area. The foliage reached (68.50 cm), (3.00 plant branches-1), and (838.64 cm2) compared to the non-spraying treatment, which gave the lowest averages of (67.50 cm), (2.75 plant branches-1), and (834.35 cm2) for the traits, respectively. Manganese also that participate in the process of respiration and the assimilation of amino acids. It is important in the liberation of oxygen in the process of photosynthesis and a number of Krebs-effect enzymes. It also has an important effect in the electron transfer system in the process of photosynthesis because it participates in oxidation reactions and Reduction (Ali, 2012).

2 Materials and Methods

A field experiment was implemented during the winter season (2022/2023), on land belonging to a farmer in the governorate, in order to study the role of magnesium and manganese of the bean crop. The factorial experiment was carried out according to the split-plate arrangement and using a randomized complete block design (R.C.B.D) with three replications. The process of plowing, smoothing and leveling was carried out. The experimental land was divided according to the design used into experimental units. The area of the experimental unit was (3x3=9m). Each experimental unit contained four lawns. The length of the meadow is 3 m. The seeds were planted on October 17 (Al-Taher et al., 2014) using a Spanish variety (Luz De Otono) on the meadow, the distance between one meadow and another is 75 cm and between one hole and another is 25 cm, by placing two seeds in each hole, and after two weeks of planting, the grafting process was carried out. The fertilization process was carried out using urea fertilizer (46% N) as a source of nitrogen at a rate of 80 kg N ha-1 in two batches, the first two weeks after emergence and the second batch was added a month after the first batch. As for potassium fertilizer, it was added at a rate of 80 kg K ha-1 in the form of potassium sulfate. (K%42) in one batch at planting (Al-Abdi, 2011), and phosphorus was added at a rate of 80 kg P-1 in the form of triple superphosphate fertilizer (P%21) and in one batch at planting (Hadhaili and Al-Hassani, 2014). Irrigation and weeding whenever necessary. Magnesium was sprayed in two batches, the first a month after planting, while the second batch was sprayed at the beginning of flowering. As for manganese, it was sprayed when the field reached 50% flowering. The spraying process was done early in the morning using a 16-litre backpack sprayer.

Random samples were taken from the experimental land and from of (0-30) cm. Some chemical and physical analyzes were carried out on them before planting the field, as in (Table 1).

Table 1: Some physical and chemical characteristics of the experimental field

Trait		Value	Unit
pH		7.82	
E.C (1:1)		4.30	des m^{-1}
Available N		28.00	mg kg $soil^{-1}$
Available P		9.8	
Available K		195	
Available Mg		180	
Available Mn		1.17	
Soil articulations	Clay	15.68	g kg^{-1}
	Silt	73.52	
	Sand	10.80	
Soil texture		Silty Loam	

Studied traits:

1-Plant height (cm): Five plants were randomly selected for each experimental unit from the two middle plots, and their height was measured using a graduated ruler from the base of the plant at the soil surface to the highest leaf on the plant when the plant reached maturity.

2-The number of branches in the plant (plant branch – 1): It represents an average of ten plants taken randomly from the two middle gardens for each experimental unit at the maturity stage.

3- Leaves content of total chlorophyll: The total chlorophyll pigment was estimated at the beginning of pod formation by weighing 0.5 grams of fresh leaves that were taken randomly from the fifth leaf (the leaf that faces the opposite direction to the sun). They were chosen from the middle two leaves randomly for each experimental unit, and then they were crushed with 10 ml of acetone, 80% concentration, to extract the dye. Then the volume was increased to 20 ml using distilled water, after which the chlorophyll pigment was estimated using a spectrophotometer at wavelengths of (663) and (645) nanometers, and then the total chlorophyll concentration was calculated according to the following equation (Goodwin, 1976):

Total Chlorophyll (mg/L) = {20.2 (O.D645)} + {8.02 (O.D 663)}.

4-Pod length (cm): It represents the average length of ten pods chosen randomly from the five plants harvested from the two middle gardens of each experimental unit, as measured at the maturity stage using a tape measure.

5- Bioyield (ton ha-1): It represents plants taken randomly when all parts of the plant above the soil surface were dry, from the two middle sizes, as it was calculated at the stage of complete maturity and converted to tons ha-1.

6- Harvest index (%): According to the harvest guide according to the following equation (Hassanin, 2020):

Harvest index (%) = economic yield (ton ha-1) / biological yield (ton ha-1) x 100

Statistical analysis: The data were analyzed according to the design used in the experiment, and by using the GenStat analysis program, the arithmetic means were compared according to the L.S.D test under the probability level of 0.05 (Al-Rawi and Khalafallah, 2000).

3 Results and Discussion

- **Plant height (cm)**

It was noted from Table (2) that there was a significant increase in plant height with increasing magnesium concentration, as the fourth concentration, Mg3, gave average, amounting to 60.30 cm, compared to the spraying treatment with distilled water only (Mg0), which gave the lowest average, amounting to 56.91 cm. This may be due to the increase in height. The plant with an increase in the concentration of magnesium in the spray solution indicates a significant and direct effect of magnesium on many biological and physiological processes in the plant, by increasing the efficiency of photosynthesis and improving growth indicators, including plant height. This result agreed with what was reached by (Yeboah et al., 2021) who showed that spraying with magnesium led to an increase in plant height. It is also clear from Table (2) that spraying the bean crop with manganese led to a significant increase in plant height, as the third concentration of manganese (Mn2) gave the highest average of 60.08 cm compared to the comparison treatment (Mn0), which gave the lowest average of 56.80 cm. This may be due to The reason for the increase in plant height when sprayed with manganese is the effect

of manganese, the assimilation of amino acids, and the release of oxygen in the process of photosynthesis, which leads to an increase in photosynthesis in the plant and thus an increase in crop growth, which is reflected in the height of the plant (on et al., 2014). As the results of (Table 2) showed, the effect of the interaction between magnesium and manganese had a significant effect on plant height, as the combination of the highest concentration of magnesium with manganese (Mg3 x Mn2) gave the highest average of 63.08 cm, while the combination (Mg1 x Mn0) gave the lowest average for this characteristic was 52.00 cm.

Table 2: Effect of spraying with magnesium and manganese and their interaction on plant height (cm)

Magnesium Manganese	Mg_0	Mg_1	Mg_2	Mg_3	Average Mn
Mn_0	54.33	52.00	61.83	59.04	56.80
Mn_1	57.56	61.00	55.67	58.78	58.25
Mn_2	58.83	60.67	57.75	63.08	60.08
Average Mg	56.91	57.89	58.42	60.30	
L.S.D (0.05)	Mg		Mn		Mg x Mn
	1.315		2.388		2.721

- **Number of branches in the plant (branch plant -1)**

The results of (Table 3) indicated that there were no significant differences when spraying with magnesium and manganese and their interaction in the number of branches in the plant.

Table 3: The effect of spraying with magnesium and manganese and their interaction on the number of branches in the plant (plant branch-1)

Magnesium Manganese	Mg_0	Mg_1	Mg_2	Mg_3	Average Mn
Mn_0	4.66	4.56	4.90	4.23	4.59
Mn_1	4.56	4.76	4.56	4.96	4.71
Mn_2	5.66	4.90	5.20	5.33	5.27
Average Mg	4.96	4.74	4.88	4.84	
L.S.D (0.05)	Mg		Mn		Mg x Mn
	N.S		N.S		N.S

- **Leaves content of total chlorophyll (mg 100g-1)**

Table 4 showed that there were significant differences when spraying with magnesium in this characteristic, as the third concentration, Mg2, gave the highest average of 36.57 mg 100 g-1, which did not differ significantly from the fourth concentration, Mg3, which gave an average of 36.54 mg 100 g-1. In contrast, the comparison treatment gave Mg0 the lowest mean of 22.81 mg 100 g-1. The increase in the chlorophyll content of the leaves may be because spraying with magnesium led to an increase in chlorophyll (a) (Table 2), which led to an increase in total chlorophyll. Among them are the essential enzymes responsible for building and forming the chlorophyll molecule, which contributed to increasing the chlorophyll content in the leaves (Al-Hasany et al., 2019), (Alsultan and Alhasany, 2023), and this result agreed with (Yeboah et al., 2021) who showed that spraying with magnesium led to an increase in the chlorophyll content in the leaves.

Table (4): The role of spraying with magnesium and manganese and their interaction in total chlorophyll (mg 100 g-1)

Magnesium Manganese	Mg0	Mg1	Mg2	Mg3	Average Mn
Mn0	18.02	32.17	34.47	39.63	31.07
Mn1	23.08	28.93	38.98	31.71	30.67
Mn2	27.34	29.38	36.25	38.28	32.81
Average Mg	22.81	30.16	36.57	36.54	
L.S.D (0.05)	Mg		Mn		Mg x Mn
	4.88		N.S		N.S

- **Pod length (cm)**

The results shown in (Table 5) indicate that the third concentration (Mg2) was significantly superior to the rest of the concentrations and gave the highest average of 20.37 cm, which did not differ significantly from the fourth concentration (Mg3) which gave an average of 20.24 cm, while the comparison treatment gave the lowest average. It reached 19.36 cm. The reason for the increase may be attributed to the direct effect of magnesium in the synthesis of chlorophyll, which led to an increase in the chlorophyll content in the leaves and the activation of many enzymes. Thus, it contributes to the process of photosynthesis, and increasing the products of this process leads to an increase in the vegetative growth of the plant. This result is consistent with (Al-Jabri, 2020).

The results of (Table 5) also show the significant effect of the interaction between the two study factors, as the combination (Mn2 x Mg1), represented by the second concentration of magnesium Mg1 with the concentration of manganese Mn2, gave the highest average in length of the pod, reaching 21.90 cm, while the combination (Mg1 x Mn0) gave Represented by the second concentration of magnesium, Mg1, with the comparison treatment of manganese, Mn0, lowest average reached 18.33 cm.

Table (5): Effect of spraying with magnesium and manganese and their interaction on pod length (cm)

Magnesium Manganese	Mg0	Mg1	Mg2	Mg3	Average Mn
Mn0	18.60	18.33	20.27	20.27	19.37
Mn1	19.90	18.77	19.77	20.17	19.65
Mn2	19.58	21.90	21.07	20.30	20.71
Average Mg	19.36	19.67	20.37	20.24	
L.S.D (0.05)	Mg		Mn		Mg x Mn
	0.722		N.S		1.454

- **Bioyield (t ha-1)**

It was clear from the results of (Table 6) that there was a significant effect of magnesium. The fourth concentration exceeded Mg3 and gave the highest rate of biological yield, amounting to 6.59 tons ha-1, which did not differ significantly from the third concentration, Mg2, which gave an average of 6.41 tons ha-1, with an increase rate of 16.84. % and 13.65% compared to the comparison treatment, which gave the lowest rate of 5.64 tons ha-1. This result agreed with (Thalooth et al., 2006) who showed that spraying with magnesium led to an increase in biological yield. It was also noted from the results of (Table 6) that there was a significant increase in the biological yield with an increase in the concentration of manganese, as the highest concentration of manganese Mn2 recorded the highest average biological yield of 6.62 tons ha-1, with an increase rate of 27.43% compared to the no-spraying treatment, which gave the lowest average for this characteristic. It reached 5.19 tons ha-1, and the reason for the superior Mn2 concentration may be due to an increase in plant height (Table 2). As happened A significant effect of the interaction between magnesium and manganese, as the highest concentration of magnesium Mg3 with the concentration Mn1, represented by the combination (Mg3 The lowest average for this characteristic was 4.69 tons ha-1 (Table 6).

Table (6): Effect of spraying with magnesium and manganese and their interaction on biological yield (tons ha-1)

Magnesium Manganese	Mg0	Mg1	Mg2	Mg3	Average Mn
Mn0	4.77	4.95	5.68	5.37	5.19
Mn1	6.12	4.69	6.11	8.92	6.46
Mn2	6.02	7.50	7.45	5.49	6.62
Average Mg	5.64	5.71	6.41	6.59	
L.S.D (0.05)	Mg		Mn		Mg x Mn
	0.738		0.573		1.175

- **Harvest index(%)**

The results in (Table 7) indicated that there was a significant effect when spraying with manganese, as the third concentration, Mn2, gave the highest average, amounting to 40.10%, compared to the first two concentrations, Mn0, and the second, Mn1, which gave the lowest averages, amounting to

36.40% and 33.10%, respectively. The reason for the increase in harvest index may be due to the superiority of the higher concentration of manganese Mn2 in the total seed yield, as well as its superiority in the biological yield (Table 6), which led to an increase in the harvest index, this result agreed with what was reached by (Alsultan and Alhasany, 2023). The results also showed the significant effect of the interaction between the two study factors, the combination (Mg1 x Mn1) gave the highest average of 47.10%, which did not differ significantly from the two combinations (Mg2 x Mn2) and (Mg3 x Mn2), which gave averages of 44.00% and 46.90%, respectively, while the combination (Mg3 x Mn1, represented by the highest concentration of magnesium Mg3 with the second concentration of manganese Mn1, gave the lowest average of 22.30%.

Table (7): Effect of spraying with magnesium and manganese and their interaction on harvest index (%)

Magnesium Manganese	Mg0	Mg1	Mg2	Mg3	Average Mn
Mn0	43.60	28.10	41.60	32.30	36.40
Mn1	29.00	47.10	33.90	22.30	33.10
Mn2	34.20	35.10	44.00	46.90	40.10
Average Mg	35.60	36.80	39.80	33.80	
L.S.D (0.05)	Mg		Mn		Mg x Mn
	N.S		3.57		9.63

4 Discussion

Increasing plant height with increasing the concentration of magnesium in the spray solution indicates the significant and direct role of magnesium in many biological and physiological processes in the plant, by increasing the efficiency of photosynthesis and improving growth indicators, including plant height. This result agreed with what was reached by (Al-Jabri, 2020 and Yeboah et al., 2021) who showed that spraying with magnesium led to an increase in plant height. It was also noted from the results that there was a significant increase in the biological yield with an increase in the concentration of manganese, and this result agreed with (Al-Khafaji, 2021), who showed that spraying with manganese led to an increase in the biological yield.

5 Conclusions

- We suggest conducting further experiments with manganese spraying at concentrations higher than 40 mg Mn liter-1.
- We suggest conducting future studies of the studied factors on different varieties of beans and other crops.

Recommendations:

From the results of the experiment the following is evident:

- The interaction between magnesium and manganese recorded a significant effect on plant height, pod length, biological yield, and harvest index.

References:

Abbas, S. H. (2012). Performance analysis of genotypes in beans under the influence of different levels of NPK fertilization. *Kufa Journal of Agricultural Sciences*, 4(2), 305-318.

Al-Abidi, J. I. (2011). Guide to the use of chemical and organic fertilizers in Iraq. *General Authority for Agricultural Guidance and Cooperation* - Ministry of Agriculture - Iraq.

Al-Azergawi, A. S. (2017). *The effect of spraying with gibberellin and manganese on the growth, yield and protein percentage of the mung crop Vigna radiate L.*. Master's thesis, College of Agriculture, University of Basra.

Al-Hasany, A.R. K, Faisal M. & Yahia K.C. (2019). The effect of spraying with proline and a nutritional hormonal mixture on the growth and yield of faba beans (Vicia faba L.). *Al-Muthanna Journal of Agricultural Sciences*, 7 (2): 122-132.

Ali, Nour El-Din Shawqi (2012). *Book on fertilizer technologies and their uses*. University House for Printing and Publishing. Baghdad.

Ali, N. Sh., Hamdallah, S. R. & Abdel-Wahab, A. Sh. (2014). *Soil fertility. Ministry of Higher Education and Scientific Research*. College of Agriculture - University of Baghdad.

Al-Jabri, S. M., Al-Ani, M. H. (2020). Evaluation of iron spraying and the method of adding magnesium on the yield characteristics of the Vigna radiate L. mung crop. *Journal of Educational and Scientific Studies, College of Education - Iraqi University*.

Al-Jabri, S. M. (2020). *The effect of foliar nutrition with iron and magnesium addition methods on the growth and yield of Vigna radiate L.*. Master's thesis, College of Agriculture, Anbar University.

Al-Janabi, H., Al-Moussawi, A. N. (2016). *Study of the effect of magnetic treatment of a sprayed magnesium solution on the growth and yield of three varieties of bread wheat (Tritium aestivum L.).* Master's thesis, Department of Life Sciences. College of Education for Pure Sciences - University of Karbala.

Al-Khafaji, D. A. (2021). *The effect of biological fertilization and spraying with manganese and copper on the growth and yield of wheat plants Triticum aestivum L.* Master's thesis, College of Technology - Al-Furat Al-Awsat Technical University.

Al-Rawi, Kh. M. & Khalaf Allah, A. M. (2000). *Design and analysis of agricultural experiments*. Dar Al-Kutub Foundation for Printing and Publishing. University of Al Mosul. Ministry of Higher Education and Scientific Research. The Republic of Iraq.

Al-Sultan, Z. H. & Alhasany, A. R. (2023). Effect of foliar feeding with magnesium and manganese on some physiological traits of Faba bean (vicia faba L.). *Al-Muthanna J.For Agric Sci*, 2 (10), 1-13. https://doi.org/10.52113/mjas04/10.2/20

Al-Sultan, Z., Alhasany, A. R. (2023). *Effect of spraying with magnesium and manganese on yield and its components of faba bean crop (vicia faba L.).* 4th International conference of Modern Technologies in Agricultural science.

Al-Tahir, F. M., Al-Rifai, Sh. I. & Aliwi, W. B. (2014). Response of genotypes of the bean crop Vicia faba L. to four cropping dates. *Al-Muthanna Journal of Agricultural Sciences*, 3(1).

Central Bureau of Statistics (2016). *Arab Agricultural Statistics Yearbook.* (36), 50.

Hassanein, A. M. (2020). *Crop physiology book*. Faculty of Agriculture - Al-Azhar University.

Hudhayli, K. H. & Al-Hassani, A. R. (2014). The effect of different levels of irrigation water salinity and the addition of phosphate fertilizer on the seed and protein yield of the bean crop L. Vicia faba. *Al-Muthanna Journal of Agricultural Sciences*, 2 (2): 65-71.

Qader, H. R. (2019). Effect of foliar application of phosphorus on Growth and development of *Vicia faba* L.under Magnesium levels. *ZANCO Journal of Pure and Applied Sciences*, 31(4), 173-179. https://doi.org/10.21271/zjpas.31.4.18

Thalooth, A. T., Tawfik, M. M. & Magda Mohamed, H. (2006). A Comparative Study on the Effect of Foliar Application of Zinc, Potassium and Magnesium on Growth, Yield and Some Chemical Constituents of Mungbean Plants Grown under Water Stress Conditions. *World Journal of Agricultural Sciences*, 2(1):37-46.

Verbuggen, N. & Hermans, C. (2013). Physiological and molecular responses to magnesium nutritonal imbalance in plants. *plant and soil*, 87-99. https://doi.org/10.1007/s11104-013-1589-0

Wittner, S. (1999). *Efficacy of foliar fertilizing*. Michigan State Univ .U.S.A.

Yeboah, S., Asibuo, J., Oteng-Darko, P., Adjei, E. A., Lamptey, M., Danquah, E. O., Waswa, B. & Butare, Louis. (2021). Impact of Foliar Application of Zinc and Magnesium Aminochelate on Bean Physiology and Productivity in Ghana. International *Journal of Agronomy*, 1-9. https://doi.org/10.1155/2021/9766709