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Effect of spraying with nano iron oxide and vitamin B3 on vegetative growth characteristics and mineral content of basil plant Ocimum BasilicnmL

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***Abstract*---**The experiment was conducted in the shade of the Department of Life Sciences, College of Education for Girls, Tikrit University, during the 2021 agricultural season .It was implemented as a factorial experiment according to the RCBC randomized complete block design, which included two factors, the first factor being Nano iron oxide in four concentrations (20,80,40.0 mg, L-1). The second factor is vitamin B3 in three concentrations (100,50.0 mg. L-1). And the overlap between them and three replicates for each factor .The results showed that spraying with Nano iron oxide gave the highest rate of vegetative growth and plant nutrient content compared to plants that did not spray. The treatment of spraying with vitamin B3 in the characteristics of vegetative growth and mineral content was better than the treatment of non-spray with vitamin B3As for the intervention factors, treatment F3N2 (spraying with Nano iron oxide at a concentration of 20/mg. L-1 + vitamin B3 at a concentration of 100 mg, L-1) outperformed all the interaction treatments in the vegetative growth characteristics of the plant and its mineral content.

***Keywords*---**effect spraying, nano iron oxide, vegetative growth, mineral content, Ocimum BasilicnmL.

Introduction

At the present time, plants of medical importance occupy a great place in agricultural production, as they are the main source of plant medicinal drugs and are used as a raw material for the production of some important chemical compounds (Evans 2003). Basil plant (Ocimum basilicum L.) belongs to the

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family Lamiaceae and includes approximately 50-150 species found in tropical regions in Asia, Africa, Central and South America (1980 Darrah). The species of this genus Ocimum differ in Characteristics, leaf size, flower colour, phenotype, and flavour. Among these species are the shrubby basil D.viride and the pink basil D.gratissimumThe basil plant is an important source of essential oil used in the food industry, perfumes, and cosmetics. Some types of Ocimum are used as a folk remedy in many cases, especially in Asian and African countries (Al-Dajwi, 1996). Nutrients have an important role in plant growth and development, and iron is one of these elements that influence most of the physiological processes that take place inside the plant, as it is included in the composition of ferredoxins, which is important in photosynthesis (Abu Dahi and Moayyad, 1989). It is also important in the biological nitrogen fixation and the reduction of ammonia nitrate and is used as a cofactor in the formation of chlorophyll and the formation of cytoplasm proteins important in the processes of photosynthesis and respiration.

The lack of nutrients in the plant deteriorates its growth and prosperity, so it must be provided well through the preparation of these nutrients by foliar spray, as foliar nutrition is one of the important methods of fertilization that compensates for the lack of elements in the soil that the plant cannot take through the roots, so it resorts to To this way as well as being an effective way to move nutrients better inside the plant (Al-Jawari 2002, Kuepper, 2003)In addition, the use of secondary fertilizers gives the plant a greater efficiency in absorbing elements because nanoparticles have a more available surface area for interaction, so iron nanoparticles are more effective by 10–1000 times than traditional and more common iron fertilizers (Sutherland, Filipponi,2013)Vitamins are known as organic compounds necessary for growth and are essential in most metabolic processes. They are also important to normalize metabolic processes, as spraying vitamins on plants stimulates growth by activating enzymatic reactions through their entry into biological cofactors and enzymatic accompaniments in many different vital processes. (Al-Ghabashy, 2005) One of these vitamins is vitamin B3, Nicotine amide, which is one of the types of vitamin B3 and has an important role in many vital processes of the plant to enter the installation of enzymatic accompaniments (NADP, NAD) (Al-Sahhaf, 1989) As they work with a large number of enzymes dehydrogenases, which are found in the cytoplasm, as shown (Al-Jboory, 2022). Spraying vitamin B3 on plants is of great importance in stimulating vegetative and flowering growth, so an experiment was conducted to demonstrate the effect of spraying with Nano iron and vitamin B3 in improving the vegetative growth indicators of plant basil.

Materials and Methods

The experiment was conducted in the shade of the Department of Life Sciences, College of Education for Girls, Tikrit University, during the 2021 agricultural season. By planting basil seeds in plastic pots, 30 cm high, the experiment was transferred with Patmos in a ratio of 1:1 (Table No. 1), showing the physical and chemical properties of the soil. The experiment was carried out according to a random design for sectors, at a rate of (72) pots for each worker and with three replications

The first factor: Nano iron and four levels

1. Non-spray treatment F0
2. Spray treatment F1 spraying with Nano iron at a concentration of 40 mg.L-1
3. Treatment of spray F2 with Nano iron at a concentration of 80 mg.l-1
4. Treatment of spraying f3 spraying with Nano iron in Turkey 120 mg.L-1

The second factor: Vitamin B3 (N)

1. Treatment of non-spraying with vitamin, symbolized by NO
2. Treatment of spraying with vitamin B3 at a concentration of 50 mg.l-1 and symbolized by N 1
3. Treatment of spraying with vitamin B3 at a concentration of 100 mg. L-1 and symbolized by N2

Intervening transactions

1- Spraying with a mixture of Nano iron and vitamin B3 in different concentrations
FONO No spraying, neither with Nano iron nor vitamin B3
FON1 not spraying with Nano iron and spraying with vitamin B3 at a concentration of 50 mg.l-1
FON2 No spraying with Nano iron and spraying with vitamin B3 at a concentration of 100 mg.l-1
F1NO spray with Nano iron at a concentration of 40 mg. Litre-1 and not spraying with vitamin B3
F1N1 spraying with Nano iron at a concentration of 40 mg. L-1 and spraying with vitamin B3 at a concentration of 50 mg. L-1
F1N2 spraying with Nano iron at a concentration of 80 mg. L-1 and spraying with vitamin B3 at a concentration of 100 mg. L-1
F2NO spray with Nano iron at a concentration of 80 mg. Litre-1 and not spraying with vitamin B3
F2N1 spraying with Nano iron at a concentration of 80 mg. L-1 and spraying with vitamin B3 at a concentration of 50 mg. L-1
F2N2 spraying with Nano iron at a concentration of 80 mg. L-1+ Vitamin B3 spray at a concentration of 100 mg. L-1
F3NO spray with Nano iron at a concentration of 120 mg. L-1 without Vitamin B3
F3N1 spraying with Nano iron at a concentration of 120 mg. L-1 + spray with vitamin B3 at a concentration of 50 mg. L-1
F3N2 Nano iron spray 120 mg.l-1 + 100 mg.l-1

Thus, the number of transactions becomes (12) treatments which implantation randomly in each replicate, which are consensual coefficients for the overlap of the levels of the two factors. The spraying was done in two batches between the first spray and the second ten days. Studied the following traits: plant height (cm), number of branches, plant^{-1}, number of leaves, plant-1, and leaf area (cm2, plant-1). Used the gravimetric method to calculate leaf area based on Patton (1984) and dry weight (gm) for the vegetative group, and this was done. By drying the shoots in a misleading place and in the open air, extracting the average for the experimental unit and using the sensitive scale until the weight was stable, chlorophyll was measured (mg, fresh weight). Then samples were taken for the basil plant leaves with full physiological breadth, where 0.5 gm of the fresh weight of these leaves was taken and placed in dark-coloured containers. Twenty millilitres of acetone were added to it and left in the dark. A spectrophotometer estimated total chlorophyll according to the method (Bajracharya ,1999). Then estimate the concentration of nitrogen ((N) using the Micro Caldal device and according to the method mentioned (Black,1965).

The phosphorous was estimated by the colourimetric method using a spectrophotometer, according to the method mentioned by (Mattt ,1970 .)A Flam photometer estimated potassium and iron was estimated by using an atomic absorption spectrophotometer according to the method mentioned by (Bharrgava, and Raphupathi,1999). s statistically analyzed the results according to the research design according to the (RCBD) design in factorial experiments. Duncan's polynomial test compared the arithmetic averages of the influence of the factors involved in the study and their interactions (Al-Rawi and Khalaf Allah, 2000). The data were analyzed using the Minitab statistical program by computer.

Results and Discussion

Table (1) shows the effect of spraying with Nano iron oxide and vitamin B3 and their interactions on the vegetative growth characteristics of basil plants. It is clear in the table that spraying with Nano iron caused a significant increase in the characteristics of vegetative growth compared to not spraying on plants.Also, from the above table, we find that spraying the plant with vitamin B3 caused significant positive differences for all vegetative growth traits compared to the treatment of no spraying with vitamin The spraying treatment (F3N2) was also superior to all vegetative growth characteristics compared to the control treatment and the two single spray treatments.

The same table shows that the binary interaction between iron nanoparticles and vitamin B3 was significant, in which all the overlapping treatments changed with significant increases compared to the control treatment. The treatment F3N2 (spraying with Nano iron oxide at a concentration of 120 mg, L-1 + Vitamin B3 at a concentration of 100 mg, L-1) gave the highest values in all vegetative growth characteristics, as it gave the highest plant height (51.83 cm) and the highest number of plant leaves -1 57.33)) and the number of branches , plant-1 (2000), leaf area (32.32 cm^2), dry matter percentage (29.23%) and the highest total chlorophyll content (18.92) compared to the lowest values for these traits in the control plants that were not sprayed with any of the Nano iron oxygen and vitamin B3, which gave (29.70 cm)) (25.33 number of leaves, plant-1) (8.00 branches, plant-1) (18.26 cm^2) (19.34%) (14.10 g) respectively, Figure (1) shows the effect of spraying with Nano iron oxide and vitamin B3 and their interactions in the concentration of nitrogen element, where spraying with Nano iron oxide caused a significant and clear increase in the concentration of this element compared to not spraying on the plant. As it is clear in the figure that spraying with vitamin B3 also caused significant positive differences in nitrogen concentrations compared to the treatment of not spraying with vitamin on the plant.

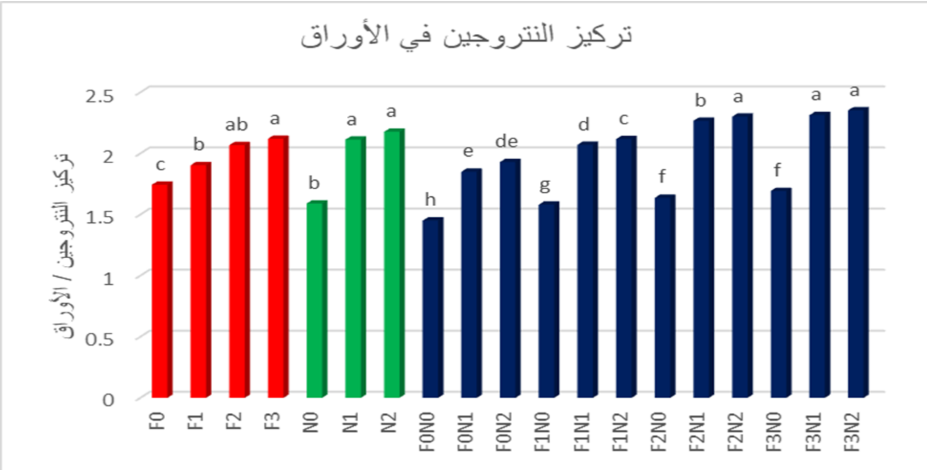

Figure (1) shows the effect of nano iron and niacin and their interactions on nitrogen concentration of basil plant.

Adjective / transaction	%N
F0	1.744 c
F1	1.904 b
F2	2.068 ab
F3	2.120 a
N0	1.590 b
N1	2.111 a
N2	2.175 a
F0N0	1.450 h
F0N1	1.850 e
F0N2	1.933 de
F1N0	1.580 g
F1N1	2.016 d
F1N2	2.116 c
F2N0	1.636 f
F2N1	2.266 b
F2N2	2.300 a
F3N0	1.693 f
F3N1	2.313 a
F3N2	2.353 a

* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test at the 5% probability level.

The same figure shows that the interaction between iron oxide nanoparticles and vitamin B3 was significant, in which the highest nitrogen concentrations distinguished the treated plants compared to the control plant. The basil plants in the F3N2 treatment gave spraying with Nano iron oxide 120 mg, L-1Vitamin B3 at a concentration of 100 mg, l-1) with the highest concentration of nitrogen in the plant reached (2.353%) compared to the other treatments and the control treatment that gave the lowest nitrogen concentration amounted to 1.450, figure (2) shows that spraying plants with Nano iron caused significant positive differences in phosphorous concentration compared to not spraying it on plants. The same figure shows that spraying plants with vitamin B3 caused a significant increase in phosphorous concentrations compared to not spraying it on plants. It is also clear from the same figure that the interaction between iron oxide nanoparticles and vitamin B3 was significant, in which the overlapping treatments caused significant

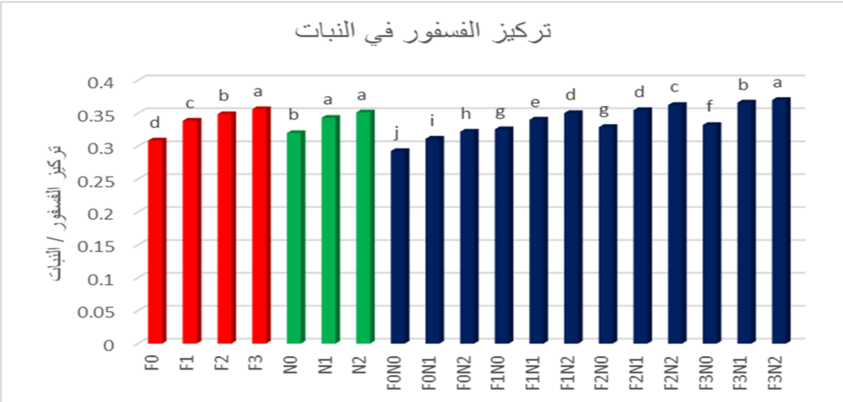

Figure (2) shows the effect of Nano iron and niacin on phosphorous concentration in basil plant

Adjective / transaction	%P
F0	0.308 d
F1	0.338 c
F2	0.348 b
F3	0.356 *a*
N0	0.319 b
N1	0.343 a
N2	0.351 a
F0N0	0.292 j
F0N1	0.311 i
F0N2	0.322 h
F1N0	0.325 g
F1N1	0.340 e
F1N2	0.530
F2N0	0.329 g
F2N1	0.354 d
F2N2	0.362 c
F3N0	0.332 f

F3N1	0.366 b
F3N2	0.370 a

* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test at the 5% probability level.

increases in phosphorous concentrations compared to the control treatment that did not spray its plants with either Nano iron or vitamin B3The treatment F3N2 was characterized by the highest concentration of phosphorous, which amounted to (0.370%) compared to the lowest in the comparison treatment FONO, which gave (0.292). Figure (3), shows the effect of spraying with Nano iron oxide and vitamin B3And their interactions with potassium concentration in basil plants. The figure shows that plants sprayed with iron-induced significant increases in potassium concentrations compared to the non-spray treatment with Nano iron. The same figure also shows that spraying with vitamin B3 has a significant positive effect on potassium concentrations compared to not spraying with vitamin B3 on the plant; the figure also shows that the two interactions of spraying with Nano iron and vitamin B3 were significant, and the overlapping treatments caused a significant increase in potassium concentrations compared to the control plants.

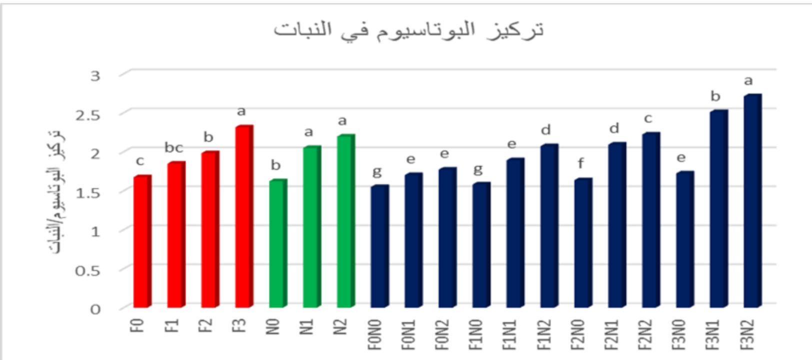

Figure No. (3) shows the effect of nano iron and niacin on potassium concentration of basil plant

Adjective / transaction	%K
FO	1.675 c
F1	1.850 bc
F2	1.984 b
F3	2.316 a
NO	1.623 b
N1	2.050 a
N2	2.196 a
FONO	1.550 g
FON1	1.703 e
FON2	1.737 e
F1NO	1.583 g

F1N1	1.893 e
F1N2	2.073 d
F2N0	1.636 f
F2N1	2.093 d
F2N2	2.223 c
F3N0	1.723 e
F3N1	2.510 b
F3N2	2.713 a

* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test at the 5% probability level.

The treatment F3N2 was characterized by the highest potassium concentration (2.713%) compared to the lowest in the comparison treatment (1.555%). The figure shows that spraying plants with Nano iron and vitamin B3 and their interactions in basil plant was spraying with Nano iron oxide caused a significant increase in iron concentrations compared to not spraying it on the plant, and the same figure shows that spraying with vitamin B3 also caused significant positive differences in iron concentrations in basil compared to not spraying on the plant as Figure (4) shows that the interaction between Nano iron and vitamin B3 was significant, in which basil plants sprayed with a mixture of Nano iron and vitamin,F3N2 with the highest concentration of iron reached (96.80 mg, kg-1). The reason for this increase in vegetative growth characteristics may be attributed to the important role of iron in redox reactions in the photosynthesis process, as well as its role in activating enzymes involved in many physiological processes, which increases the efficiency of iron. photosynthesis and building nucleic and amino acids and energy compounds (Al-Sahhaf 1989) The reason for this may also be attributed to the role of vitamin B3 in improving both the soil (Hartmute, 2005) and growth characteristics through its entry into the formation of the acetaldehyde compound. It is an intermediate component of the oxygen generator (IAA) ,which is important in elongating plant cells and increasing their numbers.

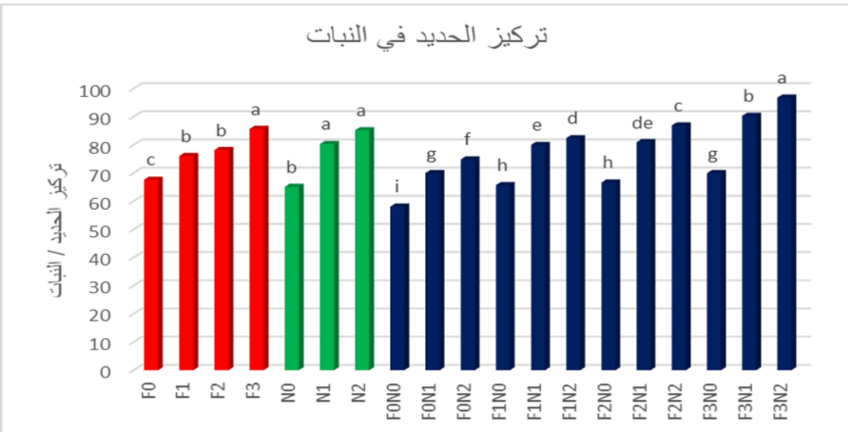

Figure No. (4) shows the effect of nano iron and niacin and their interactions on iron concentration in basil plant.

Adjective / transaction	ملغم - كلغم Fe
F0	67.64 c
F1	76.04 b
F2	78.18 b
F3	85.71 a
N0	65.11 b
N1	80.33 a
N2	85.24 a
F0N0	58.08 i
F0N1	70.01 g
F0N2	74.84 f
F1N0	65.73 h
F1N1	80.00 e
F1N2	82.41 d
F2N0	66.64 h
F2N1	80.99 de
F2N2	86.92 c
F3N0	69.99 g
F3N1	90.33 b
F3N2	96.80 a

* Columns with the same letter or similar letters above them, there are no significant differences between them according to Duncan's polynomial test at the 5% probability level

It is also an enzymatic companion in the process of carbohydrate metabolism to release the energy needed for many vital processes within cells, which causes improved growth (Rai, 2002) The reason may be attributed to the fact that vitamin B3 is included in its nitrogen components and is of effective importance for its entry into the manufacture of proteins and nucleic acids (RNA, DNA) and the synthesis of the growth hormone cytokinin, which has an important role in encouraging the growth of vegetative buds (Edesou, 1995)The increase in the concentrations of nutrients for basil plants may be attributed to the role of iron in increasing the metabolic reactions in the plant, which leads to an increase in photosynthesis and thus preserving the plant from vital stresses (Single et al,2013). Encouraging the demand for nutrients is because iron targets cell walls and increases the process of biochemical transformation(Yang et al.2016) This facilitates the permeability of nutrients into the plant and thus leads to an increase in cell divisions and thus provides a demand for nutrients that the plant works to take from the soil (Hartmuta, 2005)These increases in the concentrations of the elements may be attributed to the direct absorption of iron through the leaves and its transfer to the plant parts, which led to an increase in its concentrations, which increased the efficiency of the leaves in the photosynthesis process through their role in increasing the absorption and fixation of Co2 and then transferring the products of this process to the rest of the plant parts, the matter Which led to an increase in the absorption of nutrients to meet the needs of the plant (Al-Tamimi 2010). This increase may also be attributed to the spraying of vitamin B3, which contains nitrogen in its composition and thus increases inside the plant (Zeiger, Taiz 2016), which is of effective importance in its entry to the manufacture of proteins and acids entering In the synthesis of purines, pyrimidines, which enter the synthesis of the hormone cytokinin, which has a role In the promotion of vegetative buds and an increase in the production of amino acids, including tryptophan, which is a major source of some hormones, including oxygen. These results were in line with the findings of (Al-Jumaili 2019) that spraying basil with nano-iron causes significant positive increases in vegetative growth characteristics, as it was consistent with (Al-Zurfi, 2017), as it showed the effect of Positive spraying with vitamin B3 on the vegetative growth characteristics of the caladiolis plant. These results agree with (Al-Jubouri 2018) that spraying with nutrients increased the concentrations of nutrients in the basil plant.

Table (1): Effect of spraying with Nano iron oxide and vitamin (B3) niacin and their interactions on the vegetative growth characteristics of basil plants

	total chlorophyll	The area of the paper is cm^2	Number of branches $plant^{-1}$	Number of Leaves $Plant^{-1}$	plant height cm	dry matter percentage%
F0	14.95 c	20.78 c	11.11 c	29.22 b	34.34 a	21.86bc
F1	15.91 b	23.41 b	13.55 b	41.56 a	40.06 b	20.96c
F2	16.42 b	25.93 ab	14.66 ab	40.00 a	43.33a b	23.07c
F3	17.27 a	27.35 a	15.56 a	42.89 a	45.89 a	5.99a
N0	14.76 c	20.90 c	10.83 c	30.83 c	35.80 c	20.05b
N1	16.36 b	24.66 b	14.00 b	37.67 b	40.63 b	24.22a
N2	17.27 a	27.55 a	16.33 a	46.75 a	46.29 a	24.63a
F0N0	14.10 f	18.26 f	8.00 a	25.33 i	29.70 h	19.34f
FON1	14.90 e	21.34 e	12.66 de	32.67fg	34.33 g	23.76c
F0N2	15.87 d	22.74 d	12.66 de	29.67 h	39.00 e	22.47d
F1N0	15.05 e	20.86 e	12.00 e	32.66 fg	36.00 f	19.19f
F1N1	19.03 d	22.93 d	13.33 d	44.66 d	40.500 d	12.42e
F1N2	16.66 c	26.46 c	15.33 c	47.33 c	43.66 c	22.26d
F2N0	15.05 e	23.10 d	12.00 e	30.66 g	38.50 e	20.62e
F2N1	16.59 c	26.02 c	14.66 c	36.66 e	40.83 d	24.02c
F2N2	17.63 b	28.67 b	17.33 b	52.67 b	50.66 a	24.57c
F3NO	14.85 e	21.37 e	11.33 ef	34.66 a	39.00 e	21.65e
F3N1	17.93 b	28.34 b	15.33 c	36.66 e	46.83 b	27.68b
F3N2	18.92 a	32.32 a	20.00 a	57.33 a	51.83 a	29.23a

* Numbers with the same letter or similar letters in front of them, there are no significant differences between them, according to Duncan's polynomial test at the 5% probability level.

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