Plant Archives Volume 20 No. 2, 2020 pp. 7959-7966 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

THE USE OF NANO-FERTILIZERS FOR SOME MICRONUTRIENT AND THEIR EFFECT ON GROWTH AND YIELD OF SWEET PEPPER (*CAPSICUM ANNUM* L.)

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Abstract

A field experiment was conducted in the non-heated plastic house at Al-Mussiab Technical College for the autumn season 2017 to study the response of sweet pepper (Qurtuba cultivar) *Capsicum annum* L. to foliar spraying with two typed of Nano fertilizers in loamy sand soil. A factorial experiment was designed according to the full RCBD design, and the middles are compared by choosing the least significant difference LSD and a significant level of 5%. To study the of Iron-Nano at four levels (0, 1, 2, and 3 gm. L^{-1}) and four levels of Nano-zinc fertilizer (0, 1, 2, and 3 gm. L^{-1}) with three replicates, (2 gm. L^{-1} Nano-Fe). The results indicated to the excelling of the spraying treatment was superior (2 gm. L^{-1}) which significantly increased in plant height, number of fruit branches, leaf area of plant, dry weight of vegetative group, leaf content of chlorophyll, nitrogen, phosphorus and potassium. The number of fruits, fruit weight, and early and total yield with an increase Percentage of(30.40, 50.82, 16.55, 17.97, 25.46, 38.19, 31.37, 38.19, 16.17, 18.50, 34.69, and 40.57 %) for the above traits sequentially. Which is the same behavior as the spraying of zinc Nano at a concentration of (2- gm.L^{-1}) for the traits of plant height, number of fruit branches, dry weight of the vegetative group, leaf content of chlorophyll, nitrogen and potassium and the number of fruits and fruit weight and the early and total yield with increase Percentage (25.55, 39.95, 27.93, 36.65, 29.53, 26.0, 20.38, 15.95, 40.43 and 41.78%) sequentially as compared to the control treatment. Where (3gm. L^{-1}) was excelled in spraying treatment with Zinc Nano, in the traits leaf area and leaf content of phosphorus, where the percentages of increase amounted of (18.17% and 24.53%) sequentially. As for interaction treatments, it showed excelling the spraying treatment with a mixture of iron and zinc Nano (2 gm. L^{-1} + 2 gm. L^{-1}) by giving it the highest values for all the above traits.

Key words : sweet peppers, Qurtuba, Nano fertilizers, Fe and Zn.

Introduction

Sweet pepper (*Capsicum annum* L.) is belonging to the Solonaceae family plan, its importance back to contain vitamins A and C as well as mineral elements such as calcium, iron and phosphorus. Also it contains proteins and carbohydrates (13) Khalil, 2004. It is cultivated in Iraq by the traditional exposed method at the beginning of spring and in the protected method at the beginning of autumn. The data of the Central Bureau of Statistics, (18), 2013, indicated that the total cultivated area, for the two methods of agriculture is estimated at (33840 dunums) with total productivity of (922925 tons) and a yield of (27273 kg. $dunm^{-1}$). The use of foliar nutrients is a complementary method of soil fertilization, which is one of the highways to address the shortage of one of the important nutrients for plant growth. It is a process to ensures the homogeneous distribution of nutrient elements on plant vegetative growth as well as the high efficiency of this method in providing the plant in large quantities of the nutrient element (1) Abu Dahi, Al-yuniss. (9) Al-Ghurairi, 2003 showed with increasing demand for food, the use of foliar fertilizers increased by spraying it on the total vegetative of plant for micro or macronutrients element which encouraged the production of large quantities of fertilizers at the commercial level. Scientific experiments have indicated that most plants respond to them.

(6) Al-Juwari, 2002, Noted that plant leaf is considered as an effective part in the photosynthesis processes and most of the phylogenetic processes occurring in the plant, for this lack of nutrient elements

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shows first in the leaves. In order to treat this condition, it is preferable to add fertilizers by foliar spraying because it is more availability and thus can play their role in the metabolism processes and fixation of substance in the cells, which is reflected in the impact of plant growth and development during its various stages of growth. (5) Al-Janabi, 2005, added that the addition of fertilizers spraying on the leaves of plants is necessary in the soils of Iraq, that are exposed to the washing and sedimentation and stabilization of nutrients elements, which requires spraying this fertilizer to secure the needs of plants of these nutrients.

Iron and zinc have great importance in plant physiology. Iron has a role in the construction of chlorophyll and oxidation and reduction processes within the plant tissue, as well as in the synthesis of cytokines for photosynthesis processes (16) Barker and Stratton, 2015. While zinc plays an important role in building enzymes and proteins that contribute to cell division and metabolism of nucleic acids. It also contributes to the management of natural oxy and plant cell protection systems (12) Amiri *et al.,* 2016.

The use of Nano fertilizers is a modern technology in the process of plant fertilization. It helps to improve soil properties and activate its vital components. Adding them to plants in leaves fertilizers help increasing growth and productivity (27) Salah, 2015. The use of iron Nano fertilizer agriculture is more effective in terms of targeting their workplaces compared to the traditional compounds of this element, as well as the cost of less and use it reduces the harmful effects of the agricultural environment (29) Siva and Benita, 2016. (22) Nadi, et al, 2013) found, that the use of Nano sprayed on the leaves of *Vicia faba L.* with five concentrations resulted a significant increase in the yield at the concentration of (4 gm. L^{-1}). The percentage of the seed protein and chlorophyll also increased the total leaves and their contents of the iron element relative to the control treatment. (21) Kamari, *et al.*, 2014) found that spraying the iron Nano on *Vigna radita L.* leaves with a concentration of (250 gm. L^{-1}) resulted a significant increase in average plant height and dry leaf weight. The zinc Nano element was also used on the leaves of the plants. (17) Burman *et al.*, 2013) found that the spraying of zinc Nano on the *Cicer arietinum* L. 1.5 ppm resulted a significant increase in dry weight of the plant. While (3)Afshar *et al.*, 2014) pointed out that spraying wheat with zinc Nano led to increase the yield and the concentration of (6 gm. L^{-1}) as compared to the control treatment. (4) Altahafi and spraying different levels of zinc on the leaves of pepper which was grown in greenhouses. The concentration of (25 mg of $zinc^{-1}$) led to a significant increase in the characteristics of the rate of plant height and number of branches, the number of flowers and the proportion of the contract also achieved the characteristics of the number of fruits and their weight increased significantly by 32 and 29% sequentially as compared to the control treatment. This was reflected on the plant yield, the early and total yield of the plastic house, which achieved a significant increase of 74, 49 and 73% sequentially in comparison.

The study aims to determine sweet pepper plant to foliar spraying with two types of iron and zinc Nano fertilizers and their effect on the indicators of vegetative growth and yield.

Materials and Methods

A field experiment was conducted in the non-heated plastic house at Al-Mussaib Technical College for the autumn season 2017 to study the response of sweet pepper Capsicum annuum L. (Qurtuba cultivar), to foliar spraying with two types of zinc and iron Nano fertilizers.

The soil of the field was removed at a depth of 30 cm, which was cultivated in the previous season with vegetable crops. Instead, it used an agricultural media represented by the loamy sand soil peat moss with ratio 1: 3. The medias were then immersed in water to saturation limit and covered it with the used polyethylene, with thickness of (150 microns), for two months for the purpose of sterilization with solar energy.

Random samples were taken from three areas with a depth of 0-30 cm. The samples were mixed well. A sample was taken for analysis in the laboratory of the Soil Science Department at the Technical Institute / Mussaib under the methods mentioned by (20) Jackson, 1958 and (14) Black, 1965. (Table 1).

The land of the plastic house was divided after the sterilization to 50 plots, the width of each of them 150 cm (the width of the channel plot is 50 meters while the width of the walkway was 100 cm). The plots were irrigated two days before cultivated, the produced seedlings were cultivated in one of the private farms in the region (with 40 days' age and after the formation of 3-4 real leaves) on both sides of the plots on 12/10/2017 with distance of 40 cm between them, and 10 plants were taken to the experimental unit. The irrigation system was set up above the walkway of the plot and at a distance of 10 cm from the seedling site and left at a distance of (1 m) at the beginning and end of the plastic house. The service operations were performed such as replanting, grubbing and pruning for all experimental units. The mineral fertilizer was added with an average of (240 kg. dunam-

^{1}) of ammonium sulphate and (160 kg. dunum^{-1}) of triple superphosphate on two batches during vegetative and flowering growth, as flowering in the crop cultivation in greenhouses (8) Mohammadi, 1992. the study included 16 treatments of compatibility between two factors. The first factor included of four concentrations of iron Nano fertilizer and in levels (0, 1, 2, 3 Gl.$^{-1}$). While the second factor included four concentrations of the zinc Nano fertilizer (zero, 1, 2, 3 gm. L^{-1}). The spraying process was conducted with rate of five times, the period between them was over 20 days. The first spraying was on 20/11/2017 before the flowers appeared. A plastic isolator was used among the experimental units during spraying to ensure that the spraying solution was not transferred among the treatments. Hand-held plastic sprayers were used with (2 L) capacity for each treatment. The spraying process was conducted in the early morning preceded by the field irrigation in the previous day to ensure the opening of the stoma. The experiment was conducted according to the Randomized Complete Block Design (RCBD) with three replicates. The results were analyzed using the least significant difference (L.S.D) at the 5% probability level (7) Al-Rawi and Khalaf El-Elah, 2000).While the SAS was used for data analysis. (26)SAS, 2004.

Studied attributes: Six plants were selected randomly selected from each experimental unit and marked with the purpose of recording data for the following indicators:

Table 1: Soil specifications used in the experiment.

Traits	Unit	Value
Electrical conductivity	ds.S^{-1}	2.8
pH	—	7.5
Organic matter	g.kg^{-1} soil	9.2
Interchangeable capacity	Cmol.kg^{-1} soil	16.83
Calcium carbonate	g.kg^{-1} soil	18.7
Nitrogen availability	Cmol.kg^{-1} soil	25.4
Phosphorus availability		5.2
Potassium availability		68.7
Apparent density	μg.m^{-3}	1.42
Sand	g.kg^{-1} soil	602.6
Silt		240.1
Clay		157.3
Texture		Loamy sand soil

Length plant (cm)

This indicator was measured at the end of the growing season from the contact area of the stem with the soil to the Apical meristem for the plant by means of the metric tape.

Number of branches per plant

The number of branches bearing fruits for each experimental unit was calculated and then divided by number of plants for each experimental unit.

The leaf area of the plant (dm^2)

The leaf area of the plants for each experimental unit was measured by calculating the area of 3 completed growth leaves, which were taken from the top, middle and bottom of the plant, by using the planimeter. The plant leaves were scanned with scanning machine. The average area of the leaf by multiplied by the number of plant leaves.

Dry weight of the total vegetative (g)

The total vegetative of the plants dried at 70-65 °C in an electric oven and until the weight stability. The dry weight was then measured by a sensitive balance.

Chlorophyll content (SPAD Unit)

It was estimated by Chlorophyll meter (SPAD type) locally and on the plant directly by taking an average of three readings for every leaf and from different locations for the plant.

Leaf Content of Nutrients elements (NPK)

The fourth leaf was taken from the Apical meristem for the plants from each experimental unit after flowering (28) Shaw, 1961 then dried in an electric oven at 7^0C until its weight was stable. After that it was placed in sealed plastic bags tightly closed. The Process of wet digestion was done by taking 0.2 g of the plant sample and digested by using sulfuric acid and perchlorate in ratio 3: 5 (15) Black, 1968. After completion of the digestion process, the following elements were estimated:

A. The percentage of nitrogen: it was estimated by distillation process using Micro-Kjeldahl and according to (20) Jackson, 1958 method.

B. The percentage of Phosphorus: it was estimated by the Spectrophotometer at a wavelength of 882 nm according to (24) Olsen and Sommers, 1982. method.

C.The percentage of Potassium: it was estimated by the Flame photometer according to the method described in (15)Black, 1968.

Number of fruits of the plant

Estimated by counting the number of fruits of the experimental unit divided by the number of plants of the experimental unit.

Fruit weight (g)

It was estimated by calculating the total fruit weight of the experimental unit divided by the number of fruits for the experimental unit.

Early yield of the plant (kg)

It was calculated through the first three harvestings for the crop.

Total amount of plant (kg)

It was calculated through the sum of the total harvesting of the experimental units (15) harvestings divided by the number of their plants.

Results and Discussion

Average length of the plant and the number of fruit branches

Table 2 showed that there were significant differences between the levels of foliar spraying for pepper plant with iron and zinc Nano in the plant height and the number of fruit branches as compared to the control treatment. The treatment of iron Nano spraying with a concentration (2 ml. L^{-1})) gave the highest values to the two traits above, as it was 104.75 cm and 5.55 cm branches sequentially compared to the control treatment, which gave the lowest averages of 80.33 cm and 3.68 branches sequentially. And thus achieved an increase percentage of 30.40% and 50.82% sequentially. The same table showed that the spraying of zinc Nano element led to a significant increase in these two traits above where The spraying treatment (2 gm. L^{-1}) was excelled by giving the highest average of both factors above, which is amounted of (103.08 cm and 5.50 branches) compared to the control treatment which gave the lowest averages 82.10 cm and 3.93 branch sequentially thus achieved an increase percentage of 25.55% and 39.95% sequentially. The results showed no significant differences between the two factors (2 gm. L^{-1}) and (3 gm.L^{-1}) for both elements and both traits. The results of the data analysis showed that the interaction between the two factors had a significant effect on the increase in the average length of the plant and the number of fruit branches. The spraying treatment by a mixture of the two fertilizers (2 gm. L^{-1} Fe + 2 gm. L^{-1} Zn) gave the highest values amounted to (109.8 cm and 6.4 branches), sequentially. On the other hand, the lowest average for these two trains was at the treatment without spraying with the two fertilizers.

The average leaf area and the dry weight for the vegetative total of the plant

Table 3 showed that there were significant differences between the levels of foliar spraying for pepper plant with iron and zinc Nano elements on the traits of the leaf area and dry weight for the total vegetative compared to the control treatment. The treatment of iron Nano with a concentration of (2 gm. L^{-1}) to the traits above, they were 24.3 dm^2 and 107.98 gm as compared to the control treatment sequentially. Thus achieving an increase percentage amounted to (16.55% and 17.97%), compared to the control treatment, sequentially. The same table showed that the spraying with the zinc Nano element resulted a significant increase in the above two traits. The spraying treatment (2 gl. L^{-1}) was excelled by giving the highest values of 24.58 dm^2) in the dry weight of the vegetative group and gave the highest averages which reached 112.23 dm^2 compared to the control treatment, which gave the lowest averages of (20.80 dm^2 and 87.73 gm) sequentially. Thus achieving an increase percentage to (18.17% and 27.93%) sequentially. The results did not significantly differ with the spraying treatment between the two parameters (2 gm. L^{-1} and 3 gm. L^{-1}) for both elements and both traits. The results of the data analysis showed that the interaction between the factors had a significant effect on the increase in the average of the two traits. The spraying treatment by a mixture of the two fertilizers (2 gm. L^{-1} Fe + 2 gm. L^{-1} Zn) gave the highest values amounted to (25.2 dm^2 and 120.4 gm) sequentially. On the other hand, the lowest average for these two traits was at the treatment without spraying

Table 2: Effect of the type of Nano fertilizer between them and their interaction Average Plant Length and Number of Fruit Branches for the Plant.

Fe Gm.L^{-1}	Plant length (cm)				Average	Number of fruit branches				Fe gm.L^{-1}
	Zinc (mg. L^{-1})					Zinc (mg. L^{-1})				
	0	1	2	3		0	1	2	3	
0	52.6	76.1	97.4	95.2	80.33	2.8	3.5	4.6	3.8	3.68
1	78.3	88.4	99.5	96.3	90.63	3.6	3.9	5.2	4.4	4.28
2	101.2	105.8	109.8	102.2	104.75	4.5	5.5	6.4	5.8	5.55
3	96.3	99.7	105.6	104.3	101.48	4.8	5.3	5.8	5.6	5.38
Average	82.10	92.50	103.08	99.50		3.93	4.55	5.50	4.90	
LSD 0.05	Fe	Zn	Mn	Intr		Fe	Zn	Mn	Intr	
	7.48	7.48	7.48	13.56		0.41	0.41	0.41	0.76	

Table 3: Effect of the type of Nano fertilizer and the interaction between them in the average leaf area and dry weight for the total vegetative for Plant.

Iron Gm.L^{-1}	Leaf area for Plant (dm^2)				Average	Dry weight for the total vegetative (gm)				Average
	Zinc (gm. L^{-1})					Zinc (gm. L^{-1})				
	0	1	2	3		0	1	2	3	
0	17.4	20.5	23.8	21.7	20.85	76.5	92.2	95.1	102.3	91.53
1	20.5	21.8	24.7	22.9	22.48	84.9	88.9	114.6	110.8	99.80
2	23.7	24.5	25.2	24.3	24.43	95.2	97.6	120.4	118.7	107.98
3	21.6	23.2	24.6	24.1	23.38	94.3	96.6	108.7	117.1	104.18
Average	20.80	22.50	24.58	23.25		87.73	93.83	109.70	112.23	
LSD 0.05	Iron	Zinc	Intr			Iron	Zinc	Intr		
	1.08	1.08	1.76			7.68	7.68	14.22		

Table 4: Effect of the type of Nano fertilizer and the interaction between them in the average of chlorophyll content and the percentage of nitrogen in the leaves for Plant.

Fe Gm.L^{-1}	Chlorophyll content (spad)				Average	Nitrogen in the leaves %				Average
	Zinc (gm. L^{-1})					Zinc (gm. L^{-1})				
	0	1	2	3		0	1	2	3	
0	36.1	43.2	49.4	50.1	44.70	1.21	1.44	1.58	1.54	1.44
1	42.5	47.0	59.4	57.2	51.53	1.36	1.67	1.75	1.62	1.60
2	46.0	54.3	62.2	61.8	56.08	1.72	1.98	2.23	2.02	1.99
3	44.0	52.1	59.4	60.1	53.90	1.67	1.94	2.16	2.14	1.98
Average	42.15	49.15	57.60	57.30		1.49	1.76	1.93	1.83	
LSD 0.05	Fe	Zn	Intro			Fe	Zn	Intro		
	2.89	2.89	5.27			0.12	0.12	0.18		

with fertilizers.

Average chlorophyll content and nitrogen ratio in leaves

Table 4 showed that there were significant differences between the levels of foliar spraying for the pepper plants with the iron and zinc Nano element on the traits of content the percentage of chlorophyll and nitrogen relative to the control treatment. The spraying treatment of the Nano at a concentration of (2 gm. L-1) gave the highest values of the two traits above and it was (56.08 spad and 1.99% sequentially) compared to the control treatment, which gave the lowest averages of (44.70 spad and 1.44%) branches sequentially, thus achieving an increase percentage amounted to (25.46% and 38.19%) sequentially. The same table showed that the spraying zinc element resulted a significant increase in the two traits where the spraying treatment (2 gm. L^{-1}) was excelled by giving it the highest averages (57.60 spad and 1.93%) sequentially in comparison to the control treatment, which gave increase percentage 36.65%&29.53% sequentially. The results did not significantly differ between the two factors (2 gm. L^{-1}) and (3 gmL^{-1}) for both elements and both properties. The results of the data analysis showed that the interaction between the factorials had a significant effect on the increase in the average of the two traits. The spraying treatment by a mixture of the two fertilizers (2 gm. L^{-1} Fe + 2 gm. L^{-1} Zn) gave The highest values amounted to (62.2 spad and 2.23%) sequentially. On the other hand, the lowest average for these two traits was at the treatment without spraying with fertilizers.

Average of the leaves content of phosphorus and potassium

Table 5 showed that there was a significant difference between the levels of foliar spraying for pepper plants with iron and zinc Nano elements on the traits of leaves content of phosphoric and nitrogen content of the leaves compared to the control treatment. As the treatment of spraying with the element of iron Nano at the concentration of (2 gm. L^{-1}) gave the highest values and achieved an increase percentage to (0.67% and 1.99%) sequentially of the two traits above, compared to the control treatment, which gave the lowest averages of (0.51% and 1.44%) sequentially, thus achieving an increase percentage (31.37% and 38.19%) sequentially. The same table indicated that the spraying of the element of zinc Nano led to a significant increase in these two traits, where the spraying treatment (2 gm. L^{-1}) was excelled by giving the highest average of the phosphorus content which achieved an average amounted to (0.66%), while the spray treatment (3 gm. L^{-1}) was excelled in the treatment content of potassium and gave the highest averages of 1.89% compared to the control treatment, which gave the lowest averages of the two traits reached (0.53% and 1.50% gm) sequentially, thus achieving increase percentage amounted to (24.53 and 26.0 %) sequentially. The results showed that did not significantly differ between the factors (2 gm. L^{-1}) and (3 gm. L^{-1}) for both the two elements and both traits. The results of the data analysis showed that the interaction between the factors had a significant effect on the increase in the average of the two traits. The spraying treatment with a mixture of the two fertilizers (2 gm. L^{-1} Fe + 2 gm. L^{-1} Zn) gave the highest values amounted to (0.69% and 2.23%) sequentially. On the other hand, the lowest average for these two traits was at the treatment without spraying with fertilizer.

Average number of fruits and weight of fruit

Table 6 showed that there were significant differences between the levels of foliar spraying for the pepper plant with iron and zinc Nano elements on the traits of the number of fruits plant and the average weight of the fruit compared to the control treatment. The spraying treatment with iron Nano in a concentration (2 gm. L^{-1}) gave the highest values of the two traits above with (31.75 fruits and 99.40 gm) sequentially in comparison to the control treatment which gave the lowest averages of (27.33 fruits and 83.88 gm) sequentially, thus achieving increase percentage (16.17% and 18.50%) sequentially. The same table showed that the spraying with the zinc Nano element led to significant increase in these two traits where the spraying treatment (2 gm. L^{-1}) was excelled by giving the highest values which achieved an average increase amounted to (32.08 fruits and 97.98 gm) sequentially as compared to the control treatment, which gave the lowest averages amounted to (26.65 fruits and 84.50) sequentially, with an increase percentage of (20.38% and 15.95%) sequentially. The results showed no significant differences between the two spraying treatments (2 gm.L^{-1}) and (3 gm.L^{-1}) for both elements and both traits. The results of the data analysis showed that the interaction between the factors had a significant effect on the increase in the average of the two traits. The spraying treatment by a mixture of the two fertilizers (2 gm.L^{-1} Fe + 2 gm.L^{-1} Zn) gave the highest values amounted to (34.7 fruits and 108.3 gm) sequentially. On the other hand, the lowest averages for these two traits was at the treatment without spraying with fertilizers.

Average of early and total yield for the plant

Table 7 shows that there were significant differences between the levels of foliar spraying for the pepper plant with iron and zinc Nano on the traits of the early and total yield for the plant compared to the control treatment. The treatment of iron Nano (2 gm. L^{-1}) gave the highest vales and achieving an increase percentage amounted to (0.66 kg^{-1} plant and 2.98 kg) sequentially as compared to the control treatment, which gave the lowest averages amounted to (0.49 kg. $Plants^{-1}$ and 2.12 kg. $Plant^{-1}$) sequentially and thus achieved an increase percentage amounted to (34.69% and 40.57%) sequentially. The same table showed that the spraying with zinc Nano led to a significant increase in these two traits. The spraying treatment (2 gl^{-1}) was excelled and gave the highest values of the early yield of (0.66 kg). While the spraying treatment (3 gm. L^{-1}) gave the highest values of the total yield of (3.02 kg. $Plant^{-1)}$ sequentially compared to the control treatment, which gave the lowest averages of (0.47 kg. $Plants^{-1}$) and (2.13 kg. $Plant^{-1}$) sequentially which achieved an increase percentage of (40.43% and 41.78%) sequentially. The results showed no significant differences between the two treatments (2 gm.L^{-1}) and (3 gm.L^{-1}) for both elements and both traits. The results of the data analysis showed that the interaction between the factors had a significant effect on the increase in the

Table 5: Effect of the type of Nano fertilizer and the interaction between them in the average of the leaves content of phosphorus and potassium for Plant.

Average	Phosphor average for plant %				Average	Potassium average for plant %				Average
	Zinc (gm. L^{-1})					Zinc (gm. L^{-1})				
	0	1	2	3		0	1	2	3	
0	0.38	0.46	0.59	0.61	0.51	1.32	1.39	1.46	1.59	1.44
1	0.49	0.61	0.67	0.62	0.60	1.38	1.46	1.67	1.62	1.53
2	0.62	0.68	0.69	0.67	0.67	1.72	1.83	2.23	2.18	1.99
3	0.64	0.65	0.67	0.66	0.66	1.58	1.69	2.16	2.15	1.90
Average	0.53	0.60	0.66	0.64		1.50	1.59	1.88	1.89	
LSD 0.05	Fe 0.04	Zn 0.04	Intro 0.07			Fe 0.28	Zn 0.28	Intro 0.52		

Table 6: Effect of the type of Nano fertilizer and their interaction between them in the average number of fruits to the plant and weight of fruit for Plant.

Fe Gm.L^{-1}	Number of fruits for plant^{-1}				Average	Fruit weight (gm)				Average
	Zinc (gm. L^{-1})					Zinc (gm. L^{-1})				
	0	1	2	3		0	1	2	3	
0	23.8	27.4	29.7	28.4	27.33	78.6	81.2	87.3	88.4	83.88
1	25.3	27.7	31.8	30.5	28.83	79.9	84.5	89.6	90.1	86.03
2	28.4	31.4	34.7	32.5	31.75	89.4	93.2	108.3	106.7	99.40
3	29.1	29.01	32.1	32.9	30.80	90.1	92.1	106.7	105.5	98.60
Average	26.65	28.90	32.08	31.08		84.50	87.75	97.98	97.68	
LSD 0.05	Fe	Zn	Intro			Fe	Zn	Intro		

Table 7: Effect of the Type Nano Fertilizer and the interaction between them in the average of the early and total yield for the plant.

Fe Gm.L^{-1}	Early yield (kg.L^{-1})				Average	Total yield (kg.L^{-1})				Average
	Zinc (gm. L^{-1})					Zinc (gm. L^{-1})				
	0	1	2	3		0	1	2	3	
0	0.417	0.486	0.524	0.516	0.49	1.637	1.992	2.278	2.563	2.12
1	0.436	0.497	0.573	0.575	0.52	1.989	2.169	2.670	2.962	2.45
2	0.517	0.576	0.786	0.767	0.66	2.465	2.853	3.343	3.247	2.98
3	0.514	0.563	0.742	0.732	0.64	2.413	2.680	3.276	3.304	2.92
Average	0.47	0.53	0.66	0.65		1.13	2.42	2.89	3.02	
LSD 0.05	Fe 0.62	Zn 0.62	Intro 1.04			Fe 0.23	Zn 0.23	Intro 0.42		

average of the two traits. The spraying treatment of the mixture of the two fertilizers (2 gm.L^{-1} + 2 gm.L^{-1}) gave the highest averages of the two traits of (0.786 kg and 3.343 kg). On the other hand, the lowest average for these two traits was at the treatment without spraying with fertilizers.

The results of Tables 2, 3, 4 and 5 showed that the levels of the study spraying with the two types of fertilizers (iron and zinc) differed significantly in all indicators of vegetative and flowering growth. The level of spraying (2 gm. L^{-1} for the two fertilizers sequentially) was significantly excelled in plant height, number of branches of the plant, leaf area, dry weight of total vegetative, leaf content of chlorophyll, percentage of nitrogen, percentage of phosphorus and potassium in the leaves. The reason is that the iron element is a necessary element for plant growth and development (25) Rui *et al.,* 2016. Iron also contributes in many Bio-processes including the production of amino acids, metabolism and enzymes that help to increase cellular divisions and increase the activity of enzymes against the process of oxidation and this leads to the organization of plant growth and the promotion of activity, which reflects the increase in the indicators of vegetative growth of the plant. Nano iron characterized by high strength to penetrate the plant membranes to the functional duty. It contributes to the promotion of energy transfer and metabolism and increased cell division, which is positively reflected in the increase in plant height averages, number of branches, leaf area and concentration of elements in leaf tissue (23) Nair, *et al.*, 2010). The increasing in the number of fruit branches when they use foliar fertilization leaf with iron Nano it can be attributed that the iron component reduces the oxy tens that promote the growth of the Apical growth and therefore plant tends to the formation of fruit branches (19) CW, *et al.*, 2007. These results agreed with (11) Al-Sherbini, *et al.*, 2015, on *Pisium sativum L*. The significant effect of zinc Nano in the indicators of the vegetative growth can be attributed to its role in the formation of the amino acid tryptophan and is important in the formation of the growth regulator IAA, which in turn affects the increase of cell division and promotes the activity of cell membranes and their division and many of the biological reactions such as conservation of plant membranes of oxidation (10) Al-Sahaf, 1989 and (1) Abu Dhahi and Alyunnis, 1988 And (12) Amiri, 2016. Table 6, 7 shows a significant increase in the number of fruits and their weight and the early and total yield due to the spraying of the two types of Nano. This can be attributed to the role of Nano-nutrients (Fe and Zinc) in the synthesis and activation of many enzymes necessary for the Bio-processes in the plant as well as control the hormonal balance of the plant and this is the increase in the indicators of vegetative growth, which is reflected on the yield plant (2) Abdul Jabbar, 2012. The results of the statistical analysis showed that the interaction between the factors led to a significant increase in all indicators of vegetative growth and the yield studied. This may due to the combined effect of iron and zinc fertilizers used in the experiment.

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