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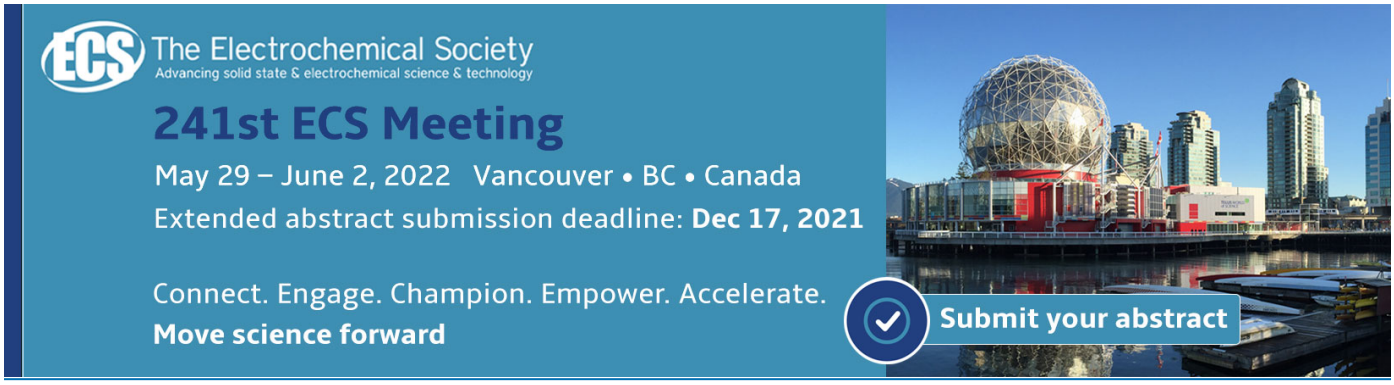

Effect of Some Nutritional Factors on The Growth and Yield of Apple cv. Ibrahimi

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Abstract

The field experiment was carried out during the planting season of 2020 in one of the private sector orchards in the Saqlawiya sub-district of Fallujah district to study the effect of foliar spraying with zinc, boron and potassium on some vegetative growth traits and the yield of apples of CV. Ibrahimi, the first factor is represented by spraying with boric acid H_3BO_3 at a Concentrations of (0 , 1) g. L^{-1}, mentioned as B0, B1, and the second factor consisted of spraying with zinc sulfate $ZnSO_4$ at a concentrations of(0 , 3) g. L^{-1} mentioned as Z0, Z1 and the third factor is spraying with potassium sulfate K_2SO_4 at concentrations (0, 2.5, 5) g. L^{-1} mentioned asK0-K1, K2 respectively. The results showed that the effect of spraying with the study factors led to a significant increase in most of the studied traits represented by (the area of one leaf, the total chlorophyll content of the leaves, the percentage of carbohydrates in the branches, the percentage of fallen fruits, the yield of one tree, the average weight of the fruit, the percentage of total sugars in the fruits, and the content of the fruits of vitamin C) reached (27.81 cm^2, 82.67mg$100g^{-1}$, 14.37%, 30.74%, 27.98kg.$tree^{-1}$, 45.13g, 8.57%, 4.87 mg$100g^{-1}$) sequentially.

Keywords :Apple growth, Zinc, Boron, Potassium.

1.Introduction

The scientific name of apple *Malus domestica* L. belongs to the Rosaceae family and is one of the most common leaves fallen fruits in temperate regions of the world, the origin of the apple is believed to be the temperate region of East Asia between the Black and Caspian Seas, and from there it spread to Europe and other parts of the world[1]. It was mentioned [2] that the apple was known in Mesopotamia at the end of the fifth millennium BC, but it was not given importance in its cultivation except in the sixties of the last century, as there was a clear care in importing some foreign varieties and propagation them in the country [3]. The global production of apples reached about 8139,326 ton, China's production ranks first with 4,139,000 ton, and the local production in Iraq is about 626,470 ton [4].

Apples are an important economic resource, especially in countries with high productivity. The fruits are used fresh in industries to make jams, juices and vinegar. Apple fruits have a high nutritional value, as they are rich in pectin and contain vitamins, proteins and carbohydrates, each 100 g of a fresh apple contains 84.5% water, 0.4 g protein, 0.6 g fat, 13.00 g carbohydrates, 90 mg carotene, 30-70 mg vitamin C, 6 mg calcium, 10 mg phosphorous and 5 mg iron. [5] and [1].

Boron is one of the essential micro-elements that are not moving inside the plant, and boric acid is the ready-to-uptake form of the plant, and the importance of this element for plant growth has been proven since 1910 [6]. Its importance is due to its primary role in cell division in the vegetative apical and root apical of plants and in leaves and new buds, as its deficiency causes the failure of plant growth, It also works to form complexes with sugar compounds and facilitates their movement and transmission within the plant and to storage sites in the fruits, and it has a regulatory role through its impact on the regulation of plant hormones [7].

Zinc is one of the basic and necessary elements for plant growth, and its deficiency or excess of the plant needs negatively affects its growth as a result of an imbalance in one or more of the many physiological processes in which it participates by being a synthetic or auxiliary component and regulator of a wide range of different enzymes as it activates many of the Enzymes, especially those related to the production of nucleic acids in the cell and protein metabolism, including the enzymes dehydrogenases[8]. Indicated [9]that spraying boron in the form of boric acid at a concentration of 20 mg L-1 on 9-year-old Anna cultivar apple trees increased the percentage of total soluble solids, sugars, hardness and total acidity of the fruits.

Potassium is one of the important major elements in plant nutrition, which contributes to increasing production in quantity and quality, and it is necessary for many physiological processes of the plant, as it activates many enzymes that participate in the construction and formation of carbohydrates, proteins and sugars [10]. It also helps in the transport of carbohydrates from the areas of their manufacture to the other parts of the plant, maintains the permeability of membranes and controls the pH of

the cell, and works to regulate the opening and closing of stomata [6]. Found that potassium and boron and their interactions significantly affected the fruit productivity of a variety of apple trees Ajami, and the total soluble solids ratio increased.
This study aims at investigating the possibility of improving the vegetative growth traits, increasing the quantity and improving the quality of the apple trees, variety Ibrahimi, by spraying the trees with boron, zinc and potassium.

2.Materials and Methods

The research was carried out in the spring season of 2020 in one of the apple orchards belonging to a farmer in the Saqlawiya sub-district of Fallujah district to study the effect of foliar spraying with zinc, boron and potassium on some vegetative growth traits and the yield of apple variety Ibrahimi, 36 trees of homogeneous growth and size were selected at the age of 4 years, planted at a distance of 4 x .5 m, and a factorial experiment was carried out according to the arrangement of Randomized Complete Blocks Design (R. C. B. D) and included three factors:-
The first factor: spraying with boric acid H_3BO_3 at a concentration of 1 g. L^{-1}, symbolized by B.
The second factor: spraying with zinc sulfate $ZnSo_4$ at a concentration of 3 g. L^{-1} and symbolized by Z.
The third factor: spraying with potassium sulfate K_2So_4 at concentrations (2.5 g. L^{-1}, 5 g. L^{-1}) respectively and symbolized by K1, K2 respectively, Thus, the experiment consists of 2 x 2 x 3 = 12 treatments with three replications, and each tree was considered an experimental unit. Thus, the total number of trees became 36. The treatments were randomly distributed within the same block. The results were analyzed using the Genstat program, and the averages were compared using the least significant difference (L.S.D)test at the level of probability 5%.
The spraying operations were applied as follows: The first spray: after the contract was completed on 1/4/2020. The second spray: 20 days after the first spray on 20/4/2020 The third spray: 20 days after the second spray on 10/5/2020 and the Fourth spray: 20 days after the third spray on 30/5/2020.
A soil sample with a depth of 5-60 cm was taken from different parts of the orchard and Table No. (1) shows some physical and chemical properties of the field soil.

Table 1. Some physical and chemical properties of the soil.

Analysis name	The analysis' results	Measuring unit
Clay	30	%
Sand	21	%
Silt	49	%
Texture	Loamy silty clay	
Organic matter	0.83	%
PH	7.6	
Lime	0.52	%
Available potassium	0.84	%
Available nitrogen	0.43	%
Available phosphorous	0.041	%

* Soil analysis was conducted in the laboratories of the Anbar Agriculture Directorate
The Measured Traits
The following responses were measured throughout the study:
Area of one leaf (cm^2).
Total chlorophyll content of leaves (mg $100g^{-1}$ fresh weight).
The percenta[g]e of carbohydrates in the branches (%).
Percentage of Fruits Fallen (%).
Yield (kg.tree-^{1}).
Average weight of the fruit (g).
Percentage of total sugars in fruits (%).
Vit. C content of fruits (mg$100g^{-1}$ fresh weight).

3.Results and Discussion

The results in Table (2) showed that the average of one leaf area has increased significantly when foliar spraying with boron, as treatment B1 excelled by giving it the highest leaf area of 25.70 cm^2 compared to the control treatment which gave 22.71 cm^2, from the results of the same table, we noted that spraying with zinc at level Z1 led to a significant increase in the area of one leaf, which amounted to 24.66 cm^2, while the level Z0 gave the lowest value, which amounted to 23.75 cm^2, and foliar spraying with potassium led to a significant increase in leaf area with each increase in spray levels, and it reached the highest increase was at the K2 level, which amounted to 26.20 cm^2 compared to the control treatment, which gave the lowest area of 22.70 cm^2. The results of the same table also indicated that the bi-interaction between boron and potassium had no significant

effect on this trait, while the bi-interaction between zinc and potassium had a significant effect. The treatment K2Z1 excelled by giving it the highest one leaf area of 27.19 cm^2 and it differed significantly from all other treatments while it gave the control treatment is the lowest value of 22.52 cm^2, The bi-interaction between zinc and boron recorded the highest leaf area when spraying with treatment B1Z1 which amounted to 25.87 cm^2 and it did not differ significantly from treatment B1Z0 which gave 25.53 cm2 while treatment B0Z0 gave the lowest value of 21.97 cm^2 and the triple interaction between boron, zinc and potassium had a significant effect on this trait. The two treatments B1Z1K2 and B1Z0K2 were superior by giving the highest one leaf area of 27.81 and 27.69 cm^2 in succession , they outperformed all other treatments, while the control treatment gave the lowest values of 21.15 cm^2.

Table 2. The effect of some nutritional factors on the average area of one leaf (cm^2) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K) K0	K1	K2	BXZ
	Z0	21.15	22.03	22.71	21.97
	Z1	21.42	22.35	26.57	23.45
B1	Z0	23.88	25.04	27.69	25.53
	Z1	24.34	25.45	27.81	25.87
L.S.D 0.05			1.05		0.61
		KXB			B
B0		21.29	22.19	24.64	22.71
B1		24.11	25.25	27.75	25.70
L.S.D 0.05			N.S		0.43
		KxZ			Z
Z0		22.52	23.54	25.20	23.75
Z1		22.88	23.90	27.19	24.66
L.S.D 0.05			0.74		0.43
Average K		22.70	23.72	26.20	
L.S.D 0.05			0.52		

The results presented in Table (3) showed that the content of leaves of chlorophyll increased significantly when foliar spraying with boron, as treatment B1 was superior by giving it the highest value of 76.67 mg.100 g^{-1} fresh weight compared to the control treatment, which gave 73.39 mg.100 g^{-1} fresh weight, from the results of the same table, we noted that spraying with zinc Z1 led to a significant increase in the rate of the aforementioned trait, which amounted to 75.61 mg.100g^{-1} fresh weight, while the Z0 level gave the lowest value of 74.44 mg.100g^{-1} fresh weight, on the other hand, spraying with potassium at the K2 level gave the highest value of 78.25 mg.100g^{-1} fresh weight compared to the control treatment, which gave the lowest value of 72.67 mg.100g^{-1} fresh weight. As for the bi-interactions, the results of the same table indicated that there were significant differences between the interaction treatments at the interaction of boron and potassium at the K2B1 level, as it gave the highest content of chlorophyll in the leaves of 81.50 mg.100 g^{-1} fresh weight, while the control treatment recorded the lowest value of 71.00 mg. 100g^{-1} fresh weight, , while the interaction between zinc and potassium and the interaction between zinc and boron had no significant effect on this trait. While the same table indicates a significant effect of the interaction between the study factors on the chlorophyll content of leaves, B1Z1K2 treatment was superior by giving it the highest value of 82.67 mg.100g^{-1} fresh weight, while the control treatment gave the lowest value of 69.67 mg.100g^{-1} fresh weight.

The results presented in Table (4) indicated that the percentage of carbohydrates in the branches increased significantly when foliar spraying with boron, as treatment B1 was superior by giving it the highest percentage amounting to 13.52% compared to the control treatment, which gave 12.01%. from the results of the same table, we note that spraying with zinc Z1 led to a significant increase in the rate of the aforementioned trait, which amounted to 12.98%, while the Z0 level gave the lowest percentage of 12.55%, on the other hand, spraying with potassium at the level K2 gave the highest percentage of 13.48% compared to control treatment that gave the lowest percentage was 12.00%. As for the bi-interactions, the results of the same table indicated that there were no significant differences in the interaction of boron and potassium, while the interaction between zinc and potassium had a significant effect on this trait, the treatment K2Z0 was superior by giving it the highest percentage of carbohydrates in the branches that recorded 13.58% compared to the control that gave the lowest percentage of 11.45%, the bi-interaction of zinc and boron did not have a significant effect on this trait, but at the triple interaction between the study factors, B1Z1K2 treatment was superior by giving it the highest percentage amounting to 14.37% compared to the control treatment which gave the lowest percentage amounting to 10.23%.

Table 3. The effect of some nutritional factors on the chlorophyll content of leaves (mg.100g^{-1} fresh weight) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
B1	Z0	69.67	73.67	75.33	72.89
	Z1	72.33	74.67	74.67	73.89
	Z0	74.33	73.33	80.33	76.00
	Z1	74.33	75.00	82.67	77.33
L.S.D 0.05			1.77		N.S
		KxB			B
B0		71.00	74.17	75.00	73.39
B1		74.33	74.17	81.50	76.67
L.S.D 0.05			1.25		0.72
		KxZ			Z
Z0		72.00	73.50	77.83	74.44
Z1		73.33	74.83	78.67	75.61
L.S.D 0.05			N.S		0.72
Average K		72.67	74.17	78.25	
L.S.D 0.05			0.88		

Table 4. The effect of some nutritional factors on the percentage of carbohydrates in the branches (%)of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
B1	Z0	10.23	11.90	13.27	11.80
	Z1	11.77	12.50	12.40	12.22
	Z0	12.67	13.33	13.90	13.30
	Z1	13.33	13.53	14.37	13.74
L.S.D 0.05			0.92		N.S
		KxB			B
B0		11.00	12.20	12.83	12.01
B1		13.00	13.43	14.13	13.52
L.S.D 0.05			N.S		0.37
		KxZ			Z
Z0		11.45	12.62	13.58	12.55
Z1		12.55	13.02	13.38	12.98
L.S.D 0.05			0.65		0.37
Average K		12.00	12.82	13.48	
L.S.D 0.05			0.46		

Table (5) indicateed that foliar spraying with boron had a significant effect in reducing the percentage of fallen fruits, as the boron foliar spray treatment was characterized by giving the lowest percentage of fallen fruits amounted to 32.81% compared to the non-spray treatment, which gave the highest value of 35.97%. As for the lowest percentage of fallen fruits that reached Z1 for the foliar spray treatment with zinc, the level gave 33.97% compared to the control treatment, which recorded 34.81%. The foliar spraying treatment with potassium had a significant effect in reducing the percentage of fallen fruits, as the percentage decreased to K2 with each increase in spray levels, and the lowest percentage of fall was at the level of 32.55%, while the comparison treatment recorded the highest percentage, which gave 37.02%. The results of the same table indicate the significant effect of all bi-interactions in reducing the percentage of fallen fruits. In the bi-interaction between boron and potassium, the level K2B1 gave the lowest percentage of fallen fruits amounted to 30.79% and did not differ significantly from treatment K1B1 which gave 31.53%. While the K0B0 treatment recorded the highest percentage of 37.93% and when zinc and potassium were overlapped, treatment K2Z1 was characterized by giving it the lowest percentage of 32.54% and it did not differ significantly from K2Z0 and K1Z1 treatment, which gave 32.57 and 33.22% respectively, while the K0Z0 treatment gave the highest percentage of 37.88%, the bi-interaction between zinc and boron recorded the lowest percentage fallen of fruits when spraying with B1Z1 treatment, which amounted to 32.11%, while the comparison treatment gave the highest percentage fallen of fruits, which amounted to 36.12%. As for the triple interaction of the study factors, the treatment B1Z1K2 excelled by giving the lowest percentage of the fallen fruits amounted to 30.74%, which did not differ significantly from the treatments B1Z0K2 B1Z1K1 and B1Z0K1 which gave 30.84, 31.15, 31.91% respectively, while the control treatment gave the highest percentage of falling off, which amounted to 37.98%.

Table 5. The effect of some nutritional factors on the percentage of fallen fruits (%) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
	Z0	37.98	36.08	34.29	36.12
	Z1	37.88	35.28	34.34	35.83
B1	Z0	37.78	31.91	30.84	33.51
	Z1	34.45	31.15	30.74	32.11
L.S.D 0.05			1.36		0.78
		KxB			B
B0		37.93	35.68	34.31	35.97
B1		36.12	31.53	30.79	32.81
L.S.D 0.05			0.96		0.55
		KxZ			Z
Z0		37.88	33.99	32.57	34.81
Z1		36.17	33.22	32.54	33.97
L.S.D 0.05			0.96		0.55
Average K		37.02	33.60	32.55	
L.S.D 0.05			0.68		

Table (6) indicated that foliar spraying with boron had a significant effect on the yield of one tree, as the boron spray treatment had the highest rate of increase in the yield of one tree, amounting to 25.97 kg.tree^{-1}, while the yield decreased with the non-spray treatment, which gave the lowest value of 22.81 kg. tree $^{-1}$, the results contained in the same table showed a significant effect of spraying with zinc in giving the highest yield to the tree, which reached 24.81 kg.tree^{-1}, as compared by Z at level 1 with the control treatment, which recorded 23.97 kg.tree-1, the foliar spray with potassium had a significant effect on increasing the yield of one tree, as the yield increased with each increase in the spray levels, as it gave K2 27.02, and the highest yield was at the level kg.tree-1 relative to the control treatment that gave 22.55kg.tree^{-1}. The foliar spray with potassium had a significant effect on increasing the yield of one tree, as the yield increased with each increase in the spray levels, and the highest yield was at the K2 level, which gave 27.02 kg.tree^{-1} compared to the control treatment , which gave 22.55 kg.tree^{-1}. On the other hand, all the bi-interactions had a significant effect in increasing the yield. In the bi-interaction between boron and potassium, the level K2B1 gave the highest yield for the tree, which amounted to 27.93 kg.tree^{-1}, while the treatment of K0B0 recorded the lowest yield, which was 20.79 kg.tree^{-1}, and at the interaction of zinc and Potassium, treatment K2Z1 was distinguished by giving the highest yield to the tree, which amounted to 27.88 kg.tree^{-1}, compared to treatment K0Z0, which gave the lowest values of 22.54 kg.tree^{-1}, the bi-interaction between zinc and boron recorded the highest yield when spraying with treatment B1Z1, which amounted to 26.12 kg.tree^{-1}, without a significant difference when treatment B1Z0, which gave 25.83 kg.tree^{-1}, while the control treatment gave the lowest yield of 22.11kg.tree^{-1}. As for the triple interaction of the study factors, the B1Z1K2 treatment was superior by giving it the highest yield of 27.98 kg. tree^{-1}, which did not differ significantly from the two treatments B1Z0K2 and B0Z1K2. As for the control treatment, it gave the lowest values of 20.74 kg.tree^{-1}.

Table 6. The effect of some nutritional factors on the yield of one tree (kg tree^{-1}) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
	Z0	20.74	21.15	24.45	22.11
	Z1	20.84	21.91	27.78	23.51
B1	Z0	24.34	25.28	27.88	25.83
	Z1	24.29	26.08	27.98	26.12
L.S.D 0.05			1.35		0.78
		KxB			B
B0		20.79	21.53	26.12	22.81
B1		24.31	25.68	27.93	25.97
L.S.D 0.05			0.96		0.55
		KxZ			Z
Z0		22.54	23.21	26.17	23.97
Z1		22.57	23.99	27.88	24.81
L.S.D 0.05			0.96		0.55
Average K		22.55	23.60	27.02	
L.S.D 0.05			0.68		

The results obtained in Table (7) indicated that the average weight of one fruit increased significantly when foliar spraying with boron, as treatment B1 excelled by giving it the highest average of 39.93 g compared to the control treatment, which

gave 37.66 g, from the results of the same table, we note that foliar spraying with zinc Z1 led to a significant increase in the same studied trait and amounted to 40.02 g, and the Z0 level gave the lowest value of 37.58 g. On the other hand, foliar spraying with potassium at the K2 level gave the highest average fruit weight of 40.18 g compared to control treatment that gave the lowest average was 37.89 g. As for the bi-interactions, the results of the same table indicated that there were no significant differences at the bi-interaction between boron and potassium and at the bi-interaction between boron and zinc, while the bi-interaction between zinc and potassium had a significant effect in increasing the average weight of the fruit, as the treatment K2Z1 gave the highest average fruit weight. It was 42.45 g compared to the control treatment which gave the lowest value 37.59 g. The triple interaction between the studied factors also had a significant effect on this trait, as the treatment B1Z1K2 gave the highest average fruit weight of 45.13 g compared to the control treatment which gave the lowest value of 35.92 g.

Table 7. The effect of some nutritional factors on the average weight of one fruit (g) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
B1	Z0	35.92	36.43	37.40	36.58
	Z1	36.97	39.50	39.77	38.74
	Z0	39.27	38.03	38.43	38.58
	Z1	39.40	39.33	45.13	41.29
L.S.D 0.05			2.47		N.S
		KxB			B
B0		36.44	37.97	38.58	37.66
B1		39.33	38.68	41.78	39.93
L.S.D 0.05			N.S		1.01
		KxZ			Z
Z0		37.59	37.23	37.92	37.58
Z1		38.18	39.42	42.45	40.02
L.S.D 0.05			1.75		1.01
Average K		37.89	38.33	40.18	
L.S.D 0.05			1.23		

The results obtained in Table (8) showed a significant increase in the percentage of total sugars when foliar spraying with boron in treatment B1 gave it the highest percentage of 8.07% compared to the control treatment, which gave 7.83%, from the results of the same table, we note that foliar spraying with zinc at level Z1 led to a significant increase in the same studied trait and amounted to 8.02%, while the level Z0 gave the lowest percentage of 7.88%, and foliar spraying with potassium led to a significant increase in the percentage of sugars with each increase in the levels of potassium added. The highest increase was in the K2 level, which gave 8.13%, compared to the control treatment, which gave 7.73%. As for the binary interactions, the results of the same table indicated that there were significant differences in the interaction between boron and potassium, as the K2B1 level gave the highest percentage of 8.33%, while the control treatment recorded the lowest percentage of 7.60% whereas the interaction between zinc and boron and the interaction between potassium and zinc did not record significant differences in this characteristic. As for the triple interaction of the study factors, treatment B1Z1K2 excelled by giving it the highest percentage of total sugars, which amounted to 8.57%, while the control treatment gave the lowest values, which amounted to 7.50%.

Table 8. Effect of some nutritional factors on the percentage of total sugars (%) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
B1	Z0	7.50	7.90	7.97	7.79
	Z1	7.70	8.00	7.90	7.87
	Z0	7.83	7.97	8.10	7.97
	Z1	7.87	8.07	8.57	8.17
L.S.D 0.05			0.25		N.S
		KxB			B
B0		7.60	7.95	7.93	7.83
B1		7.85	8.02	8.33	8.07
L.S.D 0.05			0.18		0.10
		KxZ			Z
Z0		7.67	7.93	8.03	7.88
Z1		7.78	8.03	8.23	8.02
L.S.D 0.05			N.S		0.10
Average K		7.73	7.98	8.13	

The results presented in Table (9) showed that the content of the fruits of vitamin C increased significantly when foliar spraying with boron, as the treatment B1 was superior by giving it the highest value of 4.31 mg.100gm^{-1} fresh weight compared to the control treatment, which gave 4.09 mg.100 g-1 fresh weight, from the results of the same table, we note that foliar spraying with zinc Z1 led to a significant increase in the average of the aforementioned trait, which amounted to 4.37 mg.100g^{-1} fresh weight, while the Z0 level gave the lowest content of 4.03 mg.100g^{-1} fresh weight, the foliar spray with potassium at level K1 gave the highest content of 4.33 mg.100g^{-1} fresh weight, which did not differ significantly from the K2 level, which gave 4.32 mg.100g^{-1} fresh weight, while the control treatment gave the lowest content of 3.96mg.100g^{-1} fresh weight. As for the bi-interactions, the results of the same table indicated the significant effect of all the interactions in this trait when the interaction of boron and potassium, the level K2B1 gave the highest vitamin C content of 4.57 mg.100g^{-1} fresh weight, while the control treatment recorded the lowest content of 3.98 mg.100g^{-1} fresh weight, when zinc and potassium were overlapped, all the interaction treatments were characterized by giving them the highest content of vitamin C and they did not differ between them significantly. All of them differed from the comparison that gave the lowest content of 3.60 mg.100g^{-1} fresh weight. At the interaction of zinc and potassium, all the interaction treatments were characterized by giving the highest content of vitamin C and did not differ between them significantly ,all of them differed from the control, which gave the lowest content of 3.60 mg.100g^{-1} fresh weight ,the bi-interaction between zinc and boron recorded the highest content when spraying with treatment B1Z1, which amounted to 4.57 mg.100g^{-1} fresh weight compared to the control treatment that gave the lowest content of 4.01 mg.100g^{-1} fresh weight, as for the triple interaction of the study factors, the B1Z1K2 treatment was superior by giving it the highest vitamin C content of 4.87 mg.100g^{-1} fresh weight, which did not differ significantly from the treatment B1Z1K1 which gave 4.60mg.100g^{-1} fresh weight, while the control treatment was characterized by giving it the lowest vitamin C content was 3.57 mg.100g^{-1} fresh weight.

Table 9. The effect of some nutritional factors on the vitamin C content of fruits (mg.100g^{-1} fresh weight) of apple CV. Ibrahimi.

B0	Z	Potassium concentration(K)			BXZ
		K0	K1	K2	
	Z0	3.57	4.30	4.17	4.01
	Z1	4.40	4.17	3.97	4.18
B1	Z0	3.63	4.23	4.27	4.04
	Z1	4.23	4.60	4.87	4.57
L.S.D 0.05			0.33		0.19
		KxB			B
B0		3.98	4.23	4.07	4.09
B1		3.93	4.42	4.57	4.31
L.S.D 0.05			0.23		0.13
		KxZ			Z
Z0		3.60	4.27	4.22	4.03
Z1		4.32	4.38	4.42	4.37
L.S.D 0.05			0.23		0.13
Average K		3.96	4.33	4.32	
L.S.D 0.05			0.16		

The improvement in the vegetative growth indicators that we obtained when spraying with the study factors represented by the leaf area and the increase in the leaves content of chlorophyll and carbohydrates referred to in Tables (2,3,4) reflects the positive role of the factors of the research study on the plant. Boron has an important structural and physiological role in plants, as it is involved in building cell walls, adding lignins to them, manufacturing nucleic acids, RNA, and manufacturing auxin and phenols. It has an important role in the transfer of calcium from the root to the leaves, as well as an important role in the transport and storage of carbohydrates [15-17]. As for the role of zinc in increasing the indicators of vegetative growth, it may be due to its role in activating enzymatic reactions, regulating the metabolic processes of protein and carbohydrates, and the biological representation of plant hormones, especially auxins, which are produced at the apical of the branches, which work to regulate cell elongation and thus increase growth rates [8]. The reason for the increase in the indicators of vegetative growth characteristics when spraying with potassium may be attributed to the role of potassium in improving the absorption of nutrients by root hairs. It also has a role in regulating the action of auxins that increase leaf cell division [19], Potassium has an effective role in reducing the rate of transpiration by regulating the process of opening and closing stomata, and potassium contributes to encouraging the emergence of roots in seedlings and has an important role in the process of cell division and increasing the growth of meristematic tissues [20]. The reason for reducing the percentage of fallen fruits (Table 5) when spraying with boron may be attributed to the important vital activities carried out by boron, as it facilitates the movement and transmission of photosynthesis products from the leaves to the active areas of the plant [21]. The reason for the superiority of spraying with zinc in this characteristic is due to the fact that it is involved in the manufacture of the amino acid Tryptophan , which is an essential material for the manufacture of the hormone indole acetic acid (IAA), which plays an

important role in improving growth by increasing cell division and dilation [22-23]. The reduced fruit drop indicated in (Table 5) when spraying with potassium may be attributed to the role of potassium as a catalyst in facilitating the transit and transfer of other macro and micro nutrients, which are closely related to plant hormones, including auxins, which have an important role in inhibiting the work of enzymes degrading the separation zone, namely cellulase and pectinase. In addition to the important role of potassium in facilitating the passage and transfer of nutrients and sugars to the area of separation, causing inhibition of the fallen process [24,25] and therefore it is expected that the fallen rate will decrease. The increase obtained in the characteristics of the natural and chemical yield when spraying with boron, zinc and potassium may be due to the role played by the mentioned study factors in increasing the vegetative growth indicators represented by the increase in leaf area (Table 2) and the percentage of chlorophyll (Table 3), which contributed to raising its food-making efficiency, which led to an increase in the proportion of carbohydrates (Table 4), which led to improving the nutritional status of the tree and reducing competition between the fruits for food, which led to a reduction in the percentage of fallen(Table 5) and thus an increase in the number of fruits. Boron also has an important role in the movement and transmission of photosynthesis products from the leaves to the active areas of the plant by a union of boron with the hydroxyl root In sugars, alcohols, or organic acids to form esters of boric acid, whose transport is easier than the transport of sugars alone [21].

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