Journal of Crop Nutrition Science
ISSN: 2423-7353 (Print) 2538-2470 (Online)
Vol. 9, No. 1, 2023
https://jcns.ahvaz.iau.ir/ **OPEN ACCESS**

The Effect of Cytokinin and Iron on Seed Yield and Accumulation some Elements in Seed of Chickpea Genotypes under Dry land Conditions

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RESEARCH ARTICLE

ARTICLE INFO.
Received Date: *27 Dec. 2022*
Received in revised form: *29 Jan. 2023*
Accepted Date: *30 Feb. 2023*
Available online: *30 Mar. 2023*

To Cite This Article:
Kianoush Hamidian. The Effect of Cytokinin and Iron on Seed Yield and Accumulation some Elements in Seed of Chickpea Genotypes under Dry land Conditions. ***J. Crop. Nutr. Sci.,*** 9(1): 21-32, 2023.

ABSTRACT

BACKGROUND: Chickpea is the second most important legume with numerous economic and nutraceutical properties. Therefore, chickpea production needs to be increased from the current level.

OBJECTIVES: Considering that the amount of nutrients in the seeds of each plant is one of its positive nutritional characteristics, this research was conducted to investigate the role of iron and cytokinin on the increase of iron, zinc and manganese elements.

METHODS: This research was conducted in a factorial experiment using randomized complete blocks design (RCBD) with four replications in Grit Agricultural Services Center located in Eastern-North of Khorramabad of lorestan province in 2011-12 and 2012-13 cropping seasons. The treatments consisted of three cultivars: (Hashem, Azad and local mass), four levels of iron application [control (lack of consumption), 5, 10 and 15 ppm] and four levels of cytokinin (6-Benzyl aminopurin) [control (lack of consumption), 5, 10 and 15 ppm].

RESULT: The reaction of cultivars regarding the accumulation of iron, zinc and manganese elements in the seed was different compared to iron and cytokinin. The effect of iron and cytokinin was positive on the accumulation of iron in the seed, and the highest amount of iron (with an average of 72.7 $mg.kg^{-1}$) belonged to the Hashem cultivar and the application of 10 $mg.l^{-1}$ of iron and 15 $mg.l^{-1}$ of cytokinin. While with the increase of iron and cytokinin concentration, the amount of zinc and manganese accumulation in the seed decreased and the highest amount of zinc and manganese accumulation was obtained by usage of 5 ppm of iron and cytokinin.

CONCLUSION: The highest seed yield belonged to the local mass with a concentration of 15 $mg.l^{-1}$ of iron and cytokinin with an average of 179.6 grams per square meter.

KEYWORDS: *Magnesium, Microelements, Protein, Pulse, Zinc.*

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1. BACKGROUND

Peas are an inexpensive source of high-quality protein in the diet of millions of people in developing countries who cannot access animal protein for a balanced diet. The percentage of protein varies from 12.4 to 31% in different cultivars and its quality is affected by cultivar and environmental conditions (Mansur *et al*., 2009). The amount of minerals varies significantly between plant organs and its changes in the vegetative parts of the plant such as leaves, stems and roots are much more than its changes in fruits, seeds and tubers (Salardini and Mojtahedi, 1993). The amount of mineral elements of legumes is more than that of cereals, and seeds are usually rich in mineral elements (Zarinkafsh, 1997). Cytokinins mainly play a role in the formation of two-way cooperation between the plant and the symbiotic bacteria and mycorrhiza and facilitate the transfer of nutrients between the plant and the symbiont (Kraigher *et al*., 1991). Considering the role of iron in the construction of chlorophyll, spraying iron solution increases the photosynthesis of the plant and more carbohydrates are transferred to the roots, therefore the absorption of nutritional elements by the root increases and as a result the concentration of elements in plant increases (Marshner, 1995). Although most soils contain adequate total iron, the amount that is available for plants is insufficient due to various factors such as low or high soil temperature, high organic matter, low ventilation and soil compaction, high pH. , and the amount of bicarbonate and calcium carbonate depends, in addition to inappropriate soil physical properties, iron deficiency can be attributed to PO_4^- and NO_3^- anions and the concentration of heavy elements such as manganese, zinc, copper, cobalt, nickel and cadmium (Lucena, 2000). Foliar application of an element can improve the root absorption of that element or other elements through root growth and increase the absorption of nutrients, and it is probably 6 to 20 times more useful than soil application, depending on the soil texture (Ziaeyan and Malakouti, 1999). Iron deficiency occurs in different plants depending on several soil, environmental and genetic factors and causes a significant decrease in yield and product quality (Goos and Johnson, 2001). Naeve (2006) stated that foliar feeding of iron is a suitable method to eliminate iron deficiency, but this method is only effective for plants with mild yellowing symptoms (chlorosis) or in a short period of time. Spraying of iron solution and a combination of iron and zinc increased the concentration of iron in black cumin (*Nigella sativa*) leaves (Mousa *et al*., 2004). Foliar spraying of zinc and iron increased the yield and absorption of nutrients in peanut plants compared to the control, and the combined application of iron and zinc had a greater effect (Attia, 2004). The consumption of sulfur together with iron and zinc increased plant dry matter, seed yield and absorption of nutrients nitrogen, phosphorus, potassium, sulfur, iron and zinc in sunflower (Ravi *et al*., 2008). With the use of zinc sulfate and iron sulfate, seed yield, zinc and iron concentration in wheat seed increased

(Pol Shekane Pahlavan *et al*., 2006 and Soleimani, 2006). El-Masri *et al*. (2002) reported that iron foliar application increased the concentration of iron in the leaves and stems of beans.

2. OBJECTIVES

Considering that the amount of nutrients in the seeds of each plant is one of its positive nutritional characteristics, this research was conducted to investigate the role of iron and cytokinin on the increase of iron, zinc and manganese elements.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This study was performed at Grit Agricultural Services Center (48° 18' long. E; 33°32' lat. N, and 1175 m above sea level) located in 35kilometers Eastern-North of Khorramabad of lorestan province in 2011 and 2012. Experiment was conducted as a factorial experiment in randomized complete block design in four replications. The treatments consisted of three cultivars (Azad (V_1), Hashem (V_2) and Grit local mass (V_3)), four levels of cytokinin hormone [including control (no use, C0), 5 (C1), 10 (C2) and 15 (C3) milli grams per liter] and four levels of iron included(control (no consumption, F0), 5 (F1), 10 (F2) and 15 (F3) milligrams per liter). Each plot consisted of five rows with 6 m length that space between rows and plants space on rows were considered 25 and 15 cm, respectively.

3.2. Farm Management

Planting was done according to current planting date in area and atmospheric conditions in March 23, 2011and March 13, 2012. Before planting, soil sample prepared from the 0-30 cm depth and were measured the physical and chemical properties of soil (Table 1). In this study, neither macro and nor micro fertilizers were applied. The iron ($FeSO_4,7H_2O$) was sprayed in 3-4 leaf stage (45 DAP) and cytokinin (6-Benzil aminopurine) sprayed 10 days later.

Table 1. Physical and chemical properties of soil test site (2010-2011: A, 2010-2011:B)

Year	N (%)	P (ppm)	K (ppm)
A	0.085	14.8	342.2
B	0.069	11.4	367.3
Year	**Mn (ppm)**	**Zn (ppm)**	**S (ppm)**
A	8.68	1.58	80.62
B	6.65	0.95	92.45
Year	**Fe (ppm)**	**Humus (%)**	**pH**
A	8.88	1.1	7.6
B	7.42	0.9	7.3

3.3. Measured Traits

In the harvest stage, two side rows and half a meter from the beginning of each plot were removed as marginal effects, then 6 plants were removed and 20 of their seeds were randomly selected and the amount of micro elements was measured in the laboratory using atomic absorption method (AAS) were measured (Bremner, 1996).

3.4. Statistical Analysis

Data were combined analyzed using MSTAT-C software and graphs were drawn using Excel software (Ver.2010). Means were compared using Duncan's Multiple Range Test.

4. RESULT AND DISCUSSION

The results of analysis of variance showed that the triple interaction effects of genotype×iron×cytokinin on iron, zinc and manganese accumulation in seed was significant (Table 2).

Table 2. Summary of variance analysis results of treatment effects on studied traits

S.O.V	df	Fe	Zn	Mn	Seed yield
Year (Y)	1	0.137^{ns}	0.158^{ns}	0.007^{ns}	54.39^{ns}
Year*Replicate	6	902.35^{**}	2.137^{ns}	0.09^{**}	254.76^{ns}
Cultivar	2	3926.35^{**}	3.025^{**}	34.45^{**}	927.4^{**}
Year*Cultivar	2	0.0001^{ns}	0.0001^{ns}	0.0001^{ns}	0.006^{ns}
Iron	3	1206.09^{**}	821.412^{**}	33.688^{**}	11918.5^{*}
Year*Iron	3	0.0001^{ns}	0.001^{ns}	0.0001^{ns}	0.118^{ns}
Iron*Cultivar	6	337.03^{**}	64.819^{**}	3.857^{**}	2158.65^{**}
Year*Cultivar*Iron	6	0.0001^{ns}	0.0001^{ns}	0.0001^{ns}	0.052^{ns}
Cytokinin	3	241.22^{**}	552.052^{**}	51.639^{**}	11032.09^{**}
Year*Cytokinin	3	0.0001^{ns}	0.001^{ns}	0.0001^{ns}	0.07^{ns}
Cultivar*Cytokinin	6	23.62^{**}	1.121^{ns}	0.316^{**}	281.27^{**}
Year*Cultivar*Cytokinin	6	0.0001^{ns}	0.0001^{ns}	0.0001^{ns}	0.002^{ns}
Fe*Cytokinin	9	3.38^{**}	11.621^{**}	1.389^{**}	331.87^{**}
Year*Fe*Cytokinin	9	0.0001^{ns}	0.0001^{ns}	0.0001^{ns}	0.003^{ns}
Cultivar*Fe*Cytokinin	18	15.28^{**}	5.35^{**}	0.825^{**}	399.18^{**}
Year*Cultivar*Fe*Cytokinin	18	0.0001^{ns}	0.0001^{ns}	0.0001^{ns}	0.007^{ns}
Error	182	0.662	2.48	1.108	72.72
CV(%)		1.3	4.75	1.5	5.54

^{ns}, * and ** : non-significant, significant at 1 and 5 percent probability level, respectively.

4.1. *Iron*

The treatment combination of Hashem cultivar with a concentration of 15 $mg.l^{-1}$ of iron and 5 $mg.l^{-1}$ of cytokinin with 72.8 $mg.kg^{-1}$ had the highest amount of iron in seed (Table 3). The Hashem cultivar showed a better reaction in all applied treatments and stored a higher percentage of iron, this ratio was lower in case of Azad cultivar, but response of local mass was very weak. According to modification of new cultivars for more production in high-input conditions (Nooden *et al*., 1990), the higher accumulation of iron in seeds of Hashem and Azad modified cultivars can be justified. According positive correlation between cytokinin and delay in aging, as well as the correlation between concentration of cytokinin in roots and aerial organs and significant growth of aerial organs (Lilov and Andonova, 1976), cytokinin through increasing growth period and growth amount was effective on amount of iron accumulation in seed. The positive effect of iron treatment on seeds and aerial parts of various crops, including Sunflower (Ravi *et al*., 2008), Black cumin (Mousa *et al*., 2004), Wheat (Pol Shekane Pahlavan, 2006), and Bean (El-Masri *et al*, 2002) has been reported.

Table 3. The interaction effect of cultivar, iron and cytokinin on the amount of iron element accumulation in the seed based on two-year mean squares

		Seed iron concentration (mg.kg^{-1})		
Iron (ppm)	**Cytokinin (ppm)**	**V1**	**V2**	**V3**
F_0	**C_0**	58.3^{s}	63.19^{kl}	50.49^{wx}
	C_1	60.26^{pq}	64.02^{jk}	49.93^{x}
	C_2	62.58^{lm}	64.48^{j}	51.3^{w}
	C_3	63.22^{kl}	64.84^{ij}	52.8^{v}
F_1	**C_0**	64.61^{j}	71.54^{no}	50.55^{wx}
	C_1	65.57^{hi}	63.12^{l}	50.8^{w}
	C_2	66.93^{f}	64.89^{ij}	52.92^{v}
	C_3	67.97^{e}	64.3^{j}	53.42^{v}
F_2	**C_0**	70.24^{c}	64.29_{j}	60.04^{qr}
	C_1	71.9^{ab}	66.24^{fgh}	61.19^{no}
	C_2	72.7^{a}	66.53^{fg}	63.29^{kl}
	C_3	72.58^{a}	69.09d	64.93^{ij}
F_3	**C_0**	65.94^{gh}	61.1^{nop}	55.42^{u}
	C_1	72.8^{de}	61.89^{mn}	57.38^{t}
	C_2	71.6^{b}	60.71^{opq}	61.76^{mn}
	C_3	71.09^{b}	59.27^{r}	64.6^{j}

*Mean which have a least once common letter are not significant different at the 5% probability level.
V_1: Hashem cultivar, V_2: Azad cultivar and V_3: local mass.
F_0: nonuse of iron, F_1: use 5 mg.l^{-1} iron , F_2: use 10 mg.l^{-1} iron and F_3: use 15 mg.l^{-1} iron.
C_0: nonuse of cytokinin, C_1: use 5 mg.l^{-1} cytokinin , C_2: use 10 mg.l^{-1} cytokinin and C_3: use 15 mg.l^{-1} cytokinin.

Basharat *et al.* (2014) found that the consumption of 1.5% iron in two stages of flowering and branching increased the amount of iron in leaves, stems and seeds of Cowpea. Pahlavan-Rad and Pessarakli (2009) reported a 21% increase in iron in wheat seed due to iron solution spraying.

4.2. *Zinc*

Treatment combinations of Hashem and Azad cultivars at concentrations of 5 mg/l of iron and cytokinin with an average of 40.75 mg.kg^{-1} had the highest amount of zinc accumulation in seeds. In this study, up to the concentration of 5 mg.l^{-1} of iron and cytokinin, the amount of zinc accumulation in the seed increased and then decreased (Table 4). According to the negative interaction of iron and zinc (Malakouti, 2004), it is expected that the consumption of iron will decrease the concentration of zinc in the plant, but as it can be seen, at a concentration of 5 mg.l^{-1}, an increase in the accumulation of zinc in the seed was observed, that probably due to the additive effect of cytokinin with iron, which facilitated the absorption of zinc by the plant. The increase in

zinc concentration is not only related to the decrease in plant weight under deficiency conditions, but also the phenomenon of compensatory absorption is effective in increasing the concentration of this element (Koleli *et al*., 2004). Singh *et al.* (2004) by studying the effect of three low-consumption nutrients separately and in combination on C-233 chickpea cultivar, reported that iron consumption decreased the amount and absorption of zinc in chickpeas, they attributed this decrease to the antagonistic effect of iron with zinc. They gave. De Olivira *et al*. (2010) showed that the amount of zinc accumulation in the aerial organs was influenced by different sources of cytokinin and their difference was significant compared to the control.

Table 4. The interaction effect of cultivar, iron and cytokinin on the amount of zinc element accumulation in the seed based on two-year mean squares

		Seed zinc concentration (mg.kg^{-1})		
Iron (ppm)	**Cytokinin (ppm)**	**V1**	**V2**	**V3**
F_0	**C_0**	36.51^{c}	33.73^{fghij}	34^{efghi}
	C_1	39.16^{ab}	36.64^{c}	35.36^{cdef}
	C_2	35.33^{cdef}	31.22^{lmno}	33.35^{ghijk}
	C_3	34.26^{defgh}	29.24^{pq}	28.43^{q}
F_1	**C_0**	39.96^{ab}	38.5^{b}	34.44^{defgh}
	C_1	40.75^{a}	40.75^{a}	36.39^{c}
	C_2	38.33^{b}	36.53^{c}	33.39^{ghijk}
	C_3	35.73^{cde}	35.87^{cd}	30.7^{mnop}
F_2	**C_0**	35.46^{cdef}	31.75^{klm}	31.81^{klm}
	C_1	35.99^{cd}	31.23^{lmno}	33.46^{ghijk}
	C_2	34.93^{cdefg}	29.9^{nopq}	30.87^{mnop}
	C_3	31.88^{klm}	28.45^{q}	29.27^{pq}
F_3	**C_0**	32.16^{jklm}	31.22^{lmno}	31.63^{klmn}
	C_1	33.87^{fghij}	32.8^{hijkl}	32.29^{ijklm}
	C_2	28.58^{q}	29.64^{opq}	28.39^{q}
	C_3	26.46^{r}	25.4^{r}	26.1^{r}

*Mean which have a least once common letter are not significant different at the 5% probability level.
V_1: Hashem cultivar, V_2: Azad cultivar and V_3: local mass.
F_0: nonuse of iron, F_1: use 5 mg.l^{-1} iron , F_2: use 10 mg.l^{-1} iron and F_3 : use 15 mg.l^{-1} iron.
C_0: nonuse of cytokinin, C_1: use 5 mg.l^{-1} cytokinin , C_2: use 10 mg.l^{-1} cytokinin and C_3: use 15 mg.l^{-1} cytokinin.

4.3. *Manganese*

The treatment combination of Azad cultivar at concentration of 0 mg.l^{-1} of iron and 5 mg.l^{-1} of cytokinin with an average of 14.28 mg.kg^{-1} had the highest amount of manganese accumulation in seeds (Table 5). Hogston (1984) showed that in most cases iron causes a decrease in manganese in the plant, it seems that in this research, cytokinin partially reduced the negative interaction effect of Fe on Mn. Most of the manganese is found in the leaves and stems of plants, and its amount is negligible in the plant seeds. At the during of seed filling period, only a small fraction of manganese is directly absorbed from the soil, the majority of manganese is present in the vegetative organs, especially the flag leaf, which is transferred to the seed due to the phenomenon of retranslocation (Malakouti, 2000). In the study of Hamzehpour *et al*. (2010), iron consumption decreased the concentration of manganese in the spike and stem and increased it in the root.

Table 5. The interaction effect of cultivar, iron and cytokinin on the amount of manganese element accumulation in the seed based on two-year mean squares

		Seed manganese concentration (mg.kg^{-1})		
Iron (ppm)	**Cytokinin (ppm)**	**V1**	**V2**	**V3**
F$_0$	**C$_0$**	12.52^{d-l}	13.8^{abc}	13.13^{a-h}
	C$_1$	13.74^{abc}	14.28^{a}	13.77^{abc}
	C$_2$	12.03^{f-m}	12.7^{c-j}	12.77^{c-i}
	C$_3$	11.48^{j-n}	12.28^{e-l}	12.22^{e-l}
F$_1$	**C$_0$**	14.1^{ab}	13.13^{a-h}	12.7^{c-j}
	C$_1$	13.67^{a-d}	13.74^{abc}	13.38^{a-e}
	C$_2$	13.74^{abc}	13.25^{a-f}	12.09^{f-l}
	C$_3$	13.13^{a-h}	12.15^{e-l}	11.31^{lmn}
F$_2$	**C$_0$**	13.19^{a-g}	13.67^{a-d}	12.58^{c-k}
	C$_1$	12.52^{d-l}	14.22^{ab}	13.06^{b-h}
	C$_2$	12.03^{f-m}	12.62^{c-j}	12.15 $^{e-l}$
	C$_3$	10.9^{mn}	11.49^{j-n}	11.67^{i-n}
F$_3$	**C$_0$**	12^{g-m}	12.22^{e-l}	11.91^{h-n}
	C$_1$	12.7^{c-j}	12.52^{d-l}	12.45^{e-l}
	C$_2$	11.37^{klmn}	11.8^{i-n}	11.48^{j-n}
	C$_3$	10.76^{n}	11.47^{j-n}	10.88^{mn}

*Mean which have a least once common letter are not significant different at the 5% probability level.
V$_1$: Hashem cultivar, V$_2$: Azad cultivar and V$_3$: local mass.
F$_0$: nonuse of iron, F$_1$: use 5 mg.l^{-1} iron , F$_2$: use 10 mg.l^{-1} iron and F$_3$: use 15 mg.l^{-1} iron.
C$_0$: nonuse of cytokinin, C$_1$: use 5 mg.l^{-1} cytokinin , C$_2$: use 10 mg.l^{-1} cytokinin and C$_3$: use 15 mg.l^{-1} cytokinin.

While in Soni et *al.* (2001) research, iron consumption had a positive effect on manganese concentration in wheat seed, in the mentioned research, the effect of iron on manganese absorption was attributed to the acidity conditions of the plant root environment and the amount of manganese in environment. Wierzbowska and Bowszys (2008) in investigating the effect of plant hormones on the absorption and accumulation of micronutrient elements in spring wheat concluded that quintine increased 11% of manganese in the seed compared to the control. In the research conducted by Pazurkiwiz *et al*. (2011), with the increase in the concentration of quintine, the accumulation of manganese in corn leaves had a downward trend. Wierzbowska and Nowak (2002) stated that growth regulators are more effective than mineral fertilizers on Mn absorption in vegetative parts and seeds.

4.4. *Seed yield*

The triple interaction effect of cultivar × iron × cytokinin on seed yield was significant (Table 1). The highest seed yield belonged to the local mass with a concentration of 15 $mg.l^{-1}$ of iron and cytokinin with an average of 179.6 grams per square meter (Table 6). This situation shows that high levels of iron and cytokinin have the greatest effect on increasing yield, and perhaps considering the complementary role of iron and cytokinin in plant growth and development and yield components, this result is expected. Cultivar, environment and length of growth period are important factors that affect plant growth and development (Khattak *et al*., 2006 and James *et al*., 2007). Different genotypes in the same species are also different in terms of sensitivity to iron deficiency, and among the traits that are affected by the ability of genotypes to use soil iron, are the amount of dry matter and seed yield. James *et al*. (2007) in the study of two cultivars Sarah and 2Iccv- showed that the dry weight of the aerial part of chickpea was significantly affected by the genotype. By examining 40 chickpea genotypes, Biabani and Carpenter (2011) reported that commercial cultivars had lower shoot dry weight than indigenous cultivars. Ziaeian and Malakouti (1998) reported that soil and foliar application of micronutrients iron, zinc, manganese and copper increased corn yield. In this study, the positive role of iron and zinc in increasing yield was greater than that of manganese and copper. In a study, Khodarahmi *et al*. (2013) investigated the effect of different strains of rhizobium bacteria on the yield and yield components of Hashem, Arman and Azad modified chickpea cultivars. In this study, Azad variety had the highest yield and harvest index. The use of hormones has a great effect on achieving high yield, cytokinins are plant hormones that, as regulators of growth and development, play an important role in preventing the aging of organs and the mobility of tissues (Argueso *et al*., 2009). The increase in the dry weight of the aerial part of the plant can be due to the regulatory effect of the cytokinin hormone on the photosynthetic capacity and the delay in plant aging (Fatima *et al*., 2005) and the increase in plant height (Rabie, 1996).

Table 6. The interaction effect of cultivar, iron and cytokinin on the seed yield based on two-year mean squares

		Seed yield (gr.m^{-2})		
Iron (ppm)	**Cytokinin (ppm)**	**V1**	**V2**	**V3**
F_0	**C_0**	122.7^{k-o}	117.7^{pq}	141.4^{f-i}
	C_1	127.1^{j-m}	131.3^{i-m}	143.0^{fgh}
	C_2	128.4^{i-m}	148.3^{fgh}	144.8g-j
	C_3	152.6^{def}	162.1^{cde}	149.9^{efg}
F_1	**C_0**	150.6^{efg}	147.5^{e-h}	124.9^{j-m}
	C_1	155^{def}	159.2^{cde}	148.1^{fgh}
	C_2	157^{cdef}	170.0^{bcd}	159.0^{cde}
	C_3	164.5^{cde}	169.7^{bcd}	164.0^{b-e}
F_2	**C_0**	144.9^{fgh}	124.5j-n	149.0^{fgh}
	C_1	157.4^{c-f}	141.1f-i	152.2^{def}
	C_2	169.2^{bcd}	145.6fgh	158.2^{cde}
	C_3	167.5^{cde}	161.2cd	170.3bc
F_3	**C_0**	144.5^{g-j}	148.5^{fgh}	171.0^{bc}
	C_1	148^{fgh}	160.6^{cde}	172.7^{bc}
	C_2	178.7^{ab}	174.3^{bc}	179.6^{a}
	C_3	165.9^{bcd}	170.6^{bc}	179.6^{a}

*Mean which have a least once common letter are not significant different at the 5% probability level.

V_1: Hashem cultivar, V_2: Azad cultivar and V_3: local mass.

F_0: nonuse of iron, F_1: use 5 mg.l^{-1} iron , F_2: use 10 mg.l^{-1} iron and F_3 : use 15 mg.l^{-1} iron.

C_0: nonuse of cytokinin, C_1: use 5 mg.l^{-1} cytokinin , C_2: use 10 mg.l^{-1} cytokinin and C_3: use 15 mg.l^{-1} cytokinin.

5. CONCLUSION

The results of this research showed that iron and cytokinin have a positive effect on the concentration of micro-elements in seeds and the response of genotypes to their use is different. Modified cultivars stored more elements. Cytokinins through the reduction of free radicals and increasing the capacity of plant tissues for the sink activity in order to transport sugars and nutrients (especially nitrogen), delayed the senescence of the leaves and improve the source-sink ratio in the plant. Considering the role of iron in the production of chlorophyll, spraying of iron solution increased the photosynthesis of the plant, so more carbohydrates are transferred to the roots, therefore the growth and absorption of nutritional elements by the root increases and as a result, the concentration of elements in the plant increases. The highest seed yield belonged to the local mass with a concentration of 15 mg.l^{-1} of iron and cytokinin with an average of 179.6 gr.m^{-2}.

ACKNOWLEDGMENT
The authors thank all colleagues and other participants, who took part in the study.

FOOTNOTES
AUTHORS' CONTRIBUTION: All authors are equally involved.
CONFLICT OF INTEREST: Authors declared no conflict of interest.

REFRENCES
Argueso, C. T., F. J. Ferreira. and J. J. Kieber. 2009. Environmental perception avenues: the interaction of cytokinin and environmental response pathways. Plant, Cell and Environment. 32: 1147–1160.
Attia, K. K. 2004. Response of two peanut varieties to phosphorus fertilization and foliar application of certain micronutrients under sandy calcareous soil conditions. Assiut J. Agri. Sci. 35(4): 253-267.
Basharat, A., A. Abbas, A. Shafagat. and M. Tahir. 2014. Growth, Seed Yield and Quality of Mungbean as Influenced by Foliar Application of Iron Sulfate. Pakistan J. Life and Social Sci. 12(1): 20-25.
Biabani, A. and L. Carpenter-Boggs. 2011. Nitrogen fixation Potential in global chickpea mini-core collection. Biol Fertil Soils. 47: 679.
Bremner, J. M. 1996. Nitrogen Total. *In*: Sparks, D.L. Ed. Methods of Soil Analysis Part 3: Chemical Methods. SSSA Book Series 5. Soil Science Society of America. Madison. Wisconsin. 1085-1122.
De Oliveira, L. M., R. Paiva, J. R. F. Santana, F. D. Pereira, R. S. Nogueira. and L. C. Silva. 2010. Effects of cytokinins on in vitro mineral accumulation and bud development in *A.glabra*. Sci. Agrotec. Lavras. 34(6): 1439-1445.
El-Masri, M. F., A. Amberger, M. M. El-Fouly. and A. I. Rezk. 2002. Zn increased flowering and pod setting in faba beans and its interaction with Fe in relation to their contents in different plant parts. Pak. J. Biol. Sci. 5: 143-145.
Fatima, Z., A. Bano, R. Sial. and M. Aslam. 2005. Response of chickpea to plant growth regulators on nitrogen fixation and yeild. Pak. J. Bot. 40(5): 2005-2013.
Goos, R. J. and B. Johnson. 2001. Seed treatment, seeding rate, and cultivar effects on iron deficiency chlorosis of Soybean. J. Plant Nutrition. 24(8): 1255-1268.
Hamzehpour, N., M. G. Malakouti. and A. Majidi. 2010. Zinc, Iron and Manganese interactions various organs of Wheat. Iranian J. Soil Res. 24: 1-8.
Hogston, G. R. 1984. Current management practices for correcting iron deficiency of plants with emphaces on soil management. J. Plant Nutrition. 7(1-5): 25-46.
Hoogenboom, G., M. G. Huck. and C. M. Peterson. 1987. Root growth rate of soybean as affected by drought stress. Agronomy J. 79: 609-614.
James, E., T. C. Mackown. and S. C. Rao. 2007. Dry weight and nitrogen content of chickpea and winter wheat grown in pots for three rotations. J. Plant Nutrition. 30: 1541-1553.

Jordi, W., A. Schapendonk, E. Davelaar, G. M. Stoopen, C. S. Pot, R. de. Visser, J. A. Van Rhijn, S. Gan. and R. M. Amasino. 2000. Increased cytokine levels in transgenic tobacco plants have large direct and indirect effects on leaf senescence, photosynthesis and N Partitioning. Plant cell and Environment. 23: 279- 289.

Khattak, S. G., D. F. Khan, S. H. Shah, M. S. Madani. and T. Khan. 2006. Role of rhizobial inoculation in the production of chickpea. Crop and Soil and Environment. 25(2): 143-145.

Khodarahmi, M., S. H. Sabaghpour. and A. Farnia. 2013. Effect of different strains of rhizobium on seed yield and its components of improved Chickpea (Cicer arietinum L.) cultivars. Seed and Plant Prod. J. 29(3): 403-412.

Koleli, N., S. Eker. and I. Cakmak. 2004. Effect if zinc fertilization on cadmium toxicity in durum and bread wheat grown in zinc-deficient soil. Environmental pollutions. 131(3): 453-459.

Kraigher, H., A. Grayling, T. L. Wang. and D. E. Hanke. 1991. Cytokinin production by two ectomycorrhizal fungi in liquid culture. Phytochemistry. 30(7): 2249-2254.

Lilov, D. and T. Andonova. 1976. Cytokinins, growth, flower and fruit formation in Vitis vinifera. J. Grapevinr Res. 15(3): 160–170.

Lucena, J. J. 2000. Effects of bicarbonate, nitrate and other environmental factors on iron deficiency chlorosis: A review. J. Plant Nutrition. 23(11-12): 21-24.

Malakouti, M. J. 2000. Comprehensive method of diagnosis and necessity of optimal use of chemical fertilizers. Tehran. Tarbiat Modares University Press. 131 pages.

Malakouti, M. J. 2004. Balanced nutrition of wheat is a way to self-sufficiency in the country and ensuring the health of society (collection of articles), second edition. Tehran. Publication of agricultural education, commissioned by the wheat project executive of the Ministry of Jihad Agriculture. 544 pages.

Mansur, C. P., Y. B. Palled, S. I. Halikatii, P. M. Salimath, M. B. Chetti, P. M. Salimath. and M. B. Chetti. 2009. Effect of plant densities and phosphorus levels on seed yield and protein context of kinkily chickpea genotypes. Karnataka J. Agri. 22(2): 267-270.

Marschner, H. 1995. Mineral Nutrition of Higher Plants. Second edition, Academic Press Limited. Harcourt Brace and Company. Publishers. London. 347-364.

Mousa, G. T, I. H. El-Sallami. and E. F. Ali. 2004. Response of Nigella sativa L. to foliar application of gibberellic acid, benzyladenine, iron and zinc. Assiut J. Agri. Sci. (Egypt). 32(2): 141-156.

Naeve, S. L. 2006. Iron deficiency chlorosis in Soybean, Soybean seeding rate and companion crop effects. Agronomy J. 98(6): 1575-1581.

Nooden, L. D., S. Singh. and D. Stuart Letham. 1990. Correlation of xylem sap cytokinin levels with monocarpic senescence in soybean. Plant Physiol. 93: 33–39.

Pahlavan-Rad, M. R. and M. Pessarakli. 2009. Response of wheat plants to zinc, iron, and manganese applications and uptake and concentration of zinc, iron, and manganese in wheat seeds. Communications in Soil Sci. and Plant Analysis. 40(7-8): 1322-1332.

Pazurkiewicz-kocot, K., A. Kita. and A. Haduch. 2011. The effect of kinetin on the chlorophyll pigments content in leaves of Zea mays L. seedlings and accumulation of some metal ions. Inżynieria i Ochrona Środowiska. 14(4): 397-409.

Pol Shekane Pahlavan, M. R., Gh. A. Keykha, Gh. R. Eatesam, H. Akbarimoghaddam, Sh. A. Koohkan. and M. R. Naroueirad. 2006. The study of effects Zn, Fe and Mn on quantity and quality of seed Wheat. 18th World Cong. Soil Sci. July 9-15. Philadelphia. Pennsylvania. USA.

Rabie, K. A. E. 1996. Studies on the interaction between gibberellins and Benzyladenine in regulating growth yield and phytohoromone content in wheat plants. Field Crop Abstract. 49: 12.

Ravi, S., H. T. Channal, N. S. Hebsur, B. N. Patil. and P. R. Dharamtti. 2008. Effect of sulphur, zinc and iron nutrition on growth, yield, nutrient uptake and quality of Safflower (*Carthamus tinctorius* L.). Karnataka J. Agri. Sci. 21: 382-385.

Salardini, A. A., and M. Mojtahedi.1372. Principles of plant nutrition. Tehran. Tehran Univ. Pub. 435 pages.

Singh, M., S. R. Chaudhary, S. R. Sharma. and M. S. Rathor. 2004. Effect of same micronutrients on content and uptake by Chickpea (*Cicer arietimum*). Agri. Sci. Digest. 24(4): 268-270.

Soleimani, R. 2006. The effects of integrated application of micronutrient on wheat in low organic carbon conditions of alkaline soils of western Iran. 18th World Cong. Soil Sci. July 9-15. Philadelphia. Pennsylvania. USA.

Soni, M. L., A. Swarup. and M. Singh. 2001. Influence of manganese and iron application on yield and manganese and iron nutrition of wheat in a reclamied sodic soil. Current Agri. 25: 73-77.

Wierzbowska J. and G. A. Nowak. 2002. The influence of growth regulators and increasing doses of nitrogen on the phosphorus and potassium management of spring wheat. Polish J. Natural Sci. 12(3): 7-19.

Wierzbowska, J. and T. Bowszys. 2008. Effect of growth regulators applied together with different phosphorus fertilization levels on the content and accumulation of potassium, magnesium and calcium in spring wheat. J. Elementol. 13(3): 411-422.

Zarinkafsh, M. 1997. Soil fertility and production. Tehran University of Tehran Press. 372 pages.

Ziaeian, A. and M. J. Malakouti. 1998. Effects of micronutrient application and application time on increasing yield. Soil Water. 2(1): 56-62.

Ziaeian, A. and M. J. Melakouti. 1999. Greenhouse investigation of the effects of Fe, Mn, Zn and Cu consumption on wheat production in the heavily calcareous soils of Fars province. Water and Soil Sci. Res. J. 12(6).