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Effect of adding NPK compound fertilizer and spraying with chelated iron on the growth and flowering of two cultivars of African marigold

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Abstract

The experiment was conducted for the period from 8/3/2022 to 1/8/2022, to study the effect of adding NPK compound fertilizer and chelating iron spray on the growth and flowering of two cultivars of African marigold at concentrations (0, 50 and 100) mg.L^{-1}, the second factor: spraying with chelated iron at concentrations (0, 25 and 50), the third factor: two cultivars of the African marigold Taishan (orange) and Taishan (yellow), the results of the experiment showed as follows:

The cultivar Taishan (orange) in most of the vegetative and flowering characteristics of the African marigold outperformed the cultivar Taishan (yellow), as it recorded the highest values for plant height (29.73) cm, number of leaves (34.14) leaf^{-1}, and number of petals in the flowering inflorescence (193.03). Flower petal-1, inflorescence diameter 61.96 mm, total carotenoids content in inflorescences (0.17) mg 100 g dry weight.

The addition of the compound fertilizer NPK at a concentration of 100 mg.L^{-1} led to a significant superiority in most of the vegetative and flowering growth characteristics of the African marigold , as it recorded the highest values for plant height 31.22 cm, number of leaves 46.34 leaf^{-1}, and number of petals in the inflorescence 193.03 flower petals $^{-1}$, the diameter of the inflorescence is 61.96 mm and the content of total carotenoids in the inflorescence is 0.17 mg 100 g dry weight.

Spraying with chelated iron led to significant differences in the characteristics of vegetative and flowering growth of the African marigold , as the spraying with a concentration of 50 mg.L^{-1} recorded the highest values for the characteristic of plant height 31.22 cm, number of leaves 46.34 leaf^{-1}, and number of petals in the flowering inflorescence 193.03 petals Flower^{-1}, the diameter of the flower inflorescence is 61.96 mm, and the content of total carotenoids in the flower inflorescences is 0.17 mg 100 g dry weight.

Key words: addition of NPK compound fertilizer, spraying with chelated iron, African marigold .

Introduction

The African marigold belongs to *Tagetes erecta* L. belongs to the family Asteraceae, and is one of the economically important ornamental plants grown all over the world. The genus Tagetes consists of about 55 species, among which the African marigold (*Tagetes erecta* L.) and French marigold (*Tagetes patula* L.) are of commercial importance. minuta is rich in oils, farmers choose this plant because of its ability to adapt to diverse agricultural climatic conditions, its short flowering season, long flowering period, diversity in flower color and shape, and long life of flowers, it has a prominent position in landscaping and is mostly used as potted plants and is the best choice For herbaceous garden borders and French marigolds are mostly suitable for hanging baskets, window boxes, and ledges (Ashritha et al., 2022).

It has recently emerged as a major natural source of carotenoid pigments, which are widely used as nutritional supplements in poultry feed to enhance chicken skin color and egg yolk pigmentation. Plant-based compared to other synthetic carotenoids approved by the Food and Drug Administration (Kashyap et al., 2022) and thus find their applications in various industries,. , anti-inflammatories, and anti-bacterial (Addo et al., 2021).

The fertilization factor is one of the most important factors that determine the growth of the crop, as the addition of chemical fertilizers may positively affect soil properties such as soil fertility, soil structure, biological activity, and its ability to hold water and salinity, in addition to its production causing high energy

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and production costs (Abou Hussien et al, 2020; Singh et al, 2020), and that nitrogen nutrition works to regulate the action of plant hormones (auxins and cytokinins), which increases meristematic cell divisions and this is positively reflected on the vegetative total and increasing the root total, which helps increase the efficiency of the plant to absorb water and nutrients from the soil and represent them. Hou et al., (2021).), and lead Phosphorous plays an important role in regulating the metabolism of soil microorganisms and increasing the efficiency of nutrient uptake (Cheng et al., 2022).

Iron is an essential micronutrient for plants, because it affects many important physiological processes in plants and understanding iron balance in plants is pivotal, not only to improve their growth and development but also to enhance human nutrition as plants are the main food source of iron and this calls for filling the need for Iron is biologically available in the plant to solve the problem of iron deficiency, and iron contributes to the vital processes in the plant by being an activator of enzymes related to the process of respiration and electron transfer (Mahawar et al., 2022).

The experiment aimed to study the effect of adding NPK compound fertilizer and spraying with chelated iron and their interaction on the growth and flowering of two cultivars of the African marigold .

Materials and Methods

The experiment was carried out in a private orchard in Khalis district in the spring season of 2022, the experiment was conducted for the period from 3/08/2022 to 1/8/2022, to study the effect of adding NPK compound fertilizer and spraying with chelated iron on the growth and flowering of two varieties of the African marigold . The seeds of two cultivars of the African marigold imported from the Pan American seed company. The seeds were planted in cork dishes containing peat moss on 3/08/2022. The seedlings were isolated and transformed on 4/4/2022 into plastic pots with a diameter of 24 cm. Three plants were planted in Each pot in a culture medium consists of a mixture: Peat moss in a ratio of 1: 3, and the process of sterilizing the potting soil was carried out by watering with a mixture of the systemic fungicide Rodexil, the active substance (Metalaxyl (liquid) at a rate of 1.5 ml L-1 according to the manufacturer's recommendations, to the soil as a preventive addition A treatment for plants from infection with soil fungi, and the necessary service operations were carried out such as hoeing and weeding whenever needed, and the plants were covered with a shading percentage of 50% according to the recommendation mentioned in the book (Shaheen, 2008) and samples were taken from the soil of agriculture, and some of their chemical and physical properties were analyzed. In the central laboratory of Soil, water and plant analysis, University of Baghdad / College of Agricultural Engineering Sciences.

The experiment included a study of three factors: the first factor was the addition of NPK compound fertilizer (20:20:20) at concentrations (0, 50 and 100) mg.l-1 and the second factor: spraying with chelated iron at concentrations (0, 25 and 50), the third factor: two varieties of African marigold Taishan (orange) and Taishan (yellow). The plants were sprayed twice, the first after the appearance of 8-6 pairs of true leaves and the second after 30 days from the date of transplantation and with an interval of two days between spraying and another. Putting a barrier between the experimental units to prevent the spray from escaping to other treatments.

Statistical analysis of the data

The experiment was implemented with two factors (2×3×3) and with three replications according to the Randomized Complete Block Design (RCBD) and with three replications (Al-Rawi and Khalaf Allah, 2000). The experiment included 18 treatments and three replications, and in each experimental unit 8 pots in each pot. One, so the number of experimental plants is 432.

The data were analyzed according to the statistical program SAS (2003), and the arithmetic means were compared using Duncan's polynomial test at a probability level of 0.05.

Results and Discussion

Table (1) shows that the V2 variety was significantly superior to the plant height as it gave 29.73 cm compared to the V1 variety, which gave the lowest plant height, which was 27.48 cm. , As for the treatments of spraying with chelated iron, the results of the same table indicate the superiority of the spray treatment at

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the level of 50 mg L^{-1} compared to when it gave 29.88 cm in the comparison treatment that gave the lowest plant height of 27.20 cm.

The same table shows that there are significant differences for the binary interactions between the study factors. With regard to the interaction between cultivars and fertilization, the interaction between cultivar V2 and fertilization at the level of 100 mg L^{-1} was significantly outperformed, as it gave 32.81 cm compared to the interaction between cultivar V1 with the non-fertilization treatment, which gave 24.28 cm. As for the interaction between the cultivar and spraying with chelated iron, the interaction between the variety V2 with spraying at the level of 50 mg L^{-1} was significantly superior, as it gave 31.05 cm compared to the interaction between the variety V1 with the non-spray treatment, which gave 26.75 cm, and with regard to the interaction between fertilization and spraying with chelated iron The fertilization treatment at the level of 100 mg L^{-1} was superior to that of spraying at the level of 50 mg L^{-1}, as it gave 32.33 cm compared to the interaction of the control treatment, which gave 23.92 cm.

With regard to the triple interaction among the study factors, the interaction between V2 variety with fertilization at the level of 100 mg L^{-1} with spraying at the level of 50 mg L^{-1}, which gave 34.08 cm compared to the interaction of V1 variety with the comparison treatment of fertilization and spraying, which gave 23.54 cm.

Table (1). Effect of adding NPK compound fertilizer and spraying with chelated iron on the plant height characteristic of two cultivars of African marigold (cm).

Variety	Fertilization mg liter 1	Chelated iron (mg L^{-1})			Variety * Fertilization
		0	25	50	
V1	0	23.54 i	23.67 i	25.65 h	24.28 E
	50	26.62 h	29.12 ef	29.93 de	28.56 C
	100	28.61 fg	29.66 def	30.58 cd	29.62 B
V2	0	24.30 i	26.50 h	27.83 g	26.21 D
	50	27.89 g	31.33 bc	31.25 bc	30.15 B
	100	32.25 b	32.16 b	34.08 a	32.83 A
fertilization					
fertilization * chelated iron	0	23.92 e	25.08 d	26.74 c	25.25 C
	50	27.25 c	30.23 b	30.59 b	29.35 B
	100	30.43 b	30.91 b	32.33 a	31.22 A
item					
item * chelated iron	V1	26.25 e	27.48 d	28.72 c	27.48 B
	V2	28.14 c	30.00 b	31.05 a	29.73 A
chelated iron		27.20 C	29.88 A	29.88 A	

The averages that take the same letter for each factor or overlap between them do not differ significantly (P≤ 0.05) according to Duncan's polynomial test.

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Table (2) shows. The V2 variety was significantly superior in the number of leaves as it gave 34.14 leaves of plant^{-1} compared to the variety V1, which gave the lowest leaves amounted to 32.99 leaves of plant^{-1}. 20.90 leaf^{-1}, as for the treatments of spraying with chelated iron, the results of the same table indicate the superiority of the treatment of spraying at the level of 50 mg L^{-1}, as it gave 37.08 leaf^{-1}, compared to the comparison treatment, which gave the lowest leaves, amounted to 30.20 leaf^{-1}.

The same table shows that there are significant differences for the binary interactions between the study factors. With regard to the interaction between cultivars and fertilization, the interaction between cultivar V2 and fertilization at the level of 100 mg L-1 was significantly greater than the interaction between cultivar V1 and the level of 100 mg L^{-1}, as it gave 47.66 leaf^{-1} compared with the interaction between cultivar V1 with the non-fertilization treatment, which gave 19.05 leaf-1, as for the interaction between the cultivar and spraying with chelated iron, the interaction between the variety V2 with spraying at the level of 50 mg L^{-1} was significantly superior, as it gave 38.77 leaf-1 compared to the interaction between the variety V1 with the no-spray treatment, which gave 29.55 leaves Plant^{-1}, and with regard to the interaction between fertilization and spraying with chelated iron, the treatment of fertilizing at the level of 100 mg L^{-1} outperformed that of spraying at the level of 50 mg L^{-1}, which gave 51.42 leaves-1, compared to the interaction of the control treatment, which gave 17.95 leaves^{-1}.

With regard to the triple interaction among the study factors, the interaction between V2 variety with fertilization at the level of 100 mg L^{-1} with spraying at the level of 50 mg L^{-1}, which gave 53.75 leaves of a plant-1, compared with the interaction of V1 variety, the comparison treatment of fertilization and spraying, which gave 16.50 leaves plant^{-1}.

Table (2). Effect of adding NPK compound fertilizer and spraying with chelated iron on the number of leaves of two cultivars of African marigold (Leaf-1).

Variety	Fertilization mg liter 1	Chelated iron (mg L^{-1})			Variety * Fertilization
		0	25	50	
V1	0	16.50 l	19.91 k	20.75 jk	19.05 F
	50	32.66 g	35.66 f	36.33 f	34.88 C
	100	39.50 e	46.50 c	49.9 b	45.03 B
V2	0	19.41 k	21.83 j	27.00 i	22.75 E
	50	29.13 h	31.33 g	35.58 f	32.01 D
	100	44.00 d	45.25 cd	53.75 a	47.66 A
fertilization					
fertilization * chelated iron	0	17.95 i	20.87 h	23.87 g	20.90 C
	50	30.89 f	33.50 e	35.95 d	33.45 B
	100	41.75 c	54.87 b	51.42 a	46.34 A
item					
item * chelated iron	V1	29.55 f	34.02 c	35.39 b	32.99 B
	V2	30.84 e	32.80 d	38.77 a	34.14 A
chelated iron		30.20 C	33.41 B	37.08 A	

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The averages that take the same letter for each factor or overlap between them do not differ significantly (P≤ 0.05) according to Duncan's polynomial test.

The results of the experiment showed that the use of two cultivars of the African marigold Taishan (orange) and Taishan (yellow) led to significant differences in the characteristics of vegetative growth. The difference in genotypes between the two cultivars, which led to differences between the two cultivars of the African marigold , and these results are consistent with the findings of Malik et al., (2020).

The results of the experiment showed that the NPK chemical fertilization had a significant effect on the vegetative growth characteristics represented by the height of the plant and the number of leaves. It leads to equal absorption rates with growth rates, and the fertilizer contains a balanced percentage of nitrogen, which is included in the formation of amino acids, which works to increase plant activity, thus increasing plant height and number of sap leaves, (2007) and these results are consistent with what was reached (Slathia et al. 2019) .

The results of the experiment indicated that spraying with chelated iron led to a significant superiority in the characteristics of vegetative growth represented by the height of the plant and the number of leaves. By regulating stomata growth, pigment content, and antioxidants, and also by modulating the expression of genes related to iron uptake, transport and redistribution thus improving plant growth Xiao et al., (2021), this increase may be attributed to the role of chelating fertilizers which have higher utilization efficiency Without side effects, which chelate the mineral elements, enhance their ability to absorb by the plant and improve the properties of the soil as well, and make the inorganic nutrients easier and faster to transfer to the plant tissues directly by foliar spray, it works to protect the elements from fixation in the soil and transform them into A form that is not absorbed by the plant because most of the physiological diseases of plants are due to the lack of absorption of elements resulting from high soil alkalinity Rizk and Elngar (2020) and these are consistent results with the findings of (Hammadi et al., 2020; Salem et al., 2019).

floral traits

between table (3). The cultivar V2 was significantly superior to the inflorescence diameter as it gave 61.96 mm in comparison with the variety V1, which gave the lowest diameter of 59.04 mm. With regard to the treatments of spraying with chelated iron, the results of the same table indicate the superiority of the spray treatment at the level of 50 mg L^{-1}, as it gave 65.50 mm compared to the comparison treatment, which gave a diameter of 56.32 mm Flower inflorescences $^{-1}$.

The same table shows that there are significant differences for the binary interactions between the study factors. With regard to the interaction between the cultivars and the fertilization, the interaction between the V2 variety and the 100 mg L^{-1} level fertilization was significantly greater, as it gave 72.07 mm compared to the interaction between the V1 variety with the non-fertilization treatment, which gave 46.59 mm. As for the interaction between the cultivar and spraying with chelated iron, the interaction between the variety V2 and V1 with spraying at the level of 50 mg L^{-1} was significantly greater, as it gave (65.84 and 65.15) mm compared to the interaction between the variety V1 with the non-spray treatment, which gave 53.16 mm. Regarding the interaction between fertilization and spraying with chelated iron, the fertilization treatment at the level of 100 mg L^{-1} outperformed that of the spray at the level of 50 and 25 mg L^{-1}, as it gave (72.36 and 70.86) mm compared to the interaction of the control treatment, which gave 41.24 mm.

With regard to the triple interaction between the study factors, the interaction between V2 and V1 with fertilization at the level of 100 mg L^{-1} and spraying at levels 50 and 25 mg L^{-1}, which gave (73.22 and 72.26) mm compared to the interaction of V1 variety and the comparison treatment of fertilization and spraying Which gave 34.74 mm.

Table (3). Effect of adding NPK compound fertilizer and spraying with chelated iron on the inflorescence diameter of two cultivars of African marigold (mm).

Variety	Fertilization mg liter 1	Chelated iron (mg L^{-1})			Variety * Fertilization
		0	25	50	
V1	0	34.74 j	46.73 I	58.29 fg	46.59 E
	50	61.58 efg	60.21 Fg	65.72 cde	62.50 C

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	100	63.16 def	69.46 Abc	71.45 ab	68.02 B
V2	0	47.74 hi	51.61 H	57.49 g	52.28 D
	50	60.02 fg	57.73 G	66.77 bcd	61.50 C
	100	70.68 ab	72.26 A	73.27 a	72.04 A
fertilization					
fertilization * chelated iron	0	41.24 E	49.17 D	57.89 C	49.43 C
	50	60.80 C	58.97 C	66.25 B	62.00 B
	100	66.90 B	70.86 A	72.36 A	70.05 A
item					
item * chelated iron	V1	53.16 C	59.48 B	65.15 A	59.04 B
	V2	58.80 B	60.53 B	65.84 A	61.95 A
chelated iron		56.32 C	59.67 B	65.50 A	

Means that take the same letter for each factor or overlap between them do not differ significantly (P≤ 0.05) according to Duncan's polynomial test.

Among the table (4). The variety V2 was significantly superior in the number of petals in the inflorescence, as it gave 193.03 petal flower^{-1} compared to the variety V1, which gave the lowest diameter of 188.81 petal flower^{-1}. The comparison, which gave 136.33 flower petals^{-1}, as for the treatments of spraying with chelated iron, the results of the same table indicate the superiority of the treatment of spraying at the level of 50 mg L^{-1}, which gave 211.94 flower petals^{-1}, compared to the comparison treatment, which gave a number of 170.55 petals^{-1}.

The same table shows that there are significant differences for the binary interactions between the study factors. With regard to the interaction between cultivars and fertilization, the interaction between V2 variety and 100 mg L-1 fertilization was significantly outperformed, as it gave 248.55 flower petals-1 compared to the interaction between V1 variety with the non-fertilization treatment, which gave 135.11 flower petal^{-1}, as for the interaction between the cultivar and spraying with chelated iron, the interaction between the variety V2 with spraying at the level of 50 mg L^{-1} was significantly greater, as it gave (213.66) flower petal^{-1} compared to the interaction between the variety V1 with the no-spray treatment, which It gave 168.44 flower petals^{-1}, and with regard to the interaction between fertilization and spraying with chelated iron, the treatment of fertilization at the level of 100 mg L^{-1} outperformed that of spraying at the level of 50 mg L-1 as it gave (265.50) flower petal-1 compared with the interaction of the control treatment, which gave 112.66 flower petal^{-1}.

As for the triple interaction between the study factors, the interaction between V2 and V1 with fertilization at the level of 100 mg L^{-1} and spraying at levels 50 and 25 mg L^{-1}, as it gave (267.33 and 263.66) flower petals-1, compared with the interaction of V1 and V2 with comparison treatment of fertilization and spraying which gave (112.00 and 113.33) flower petals^{-1}.

Table (4). The effect of adding NPK compound fertilizer and spraying with chelated iron on the characteristics of the number of petals in the inflorescence of two cultivars of African marigold (flower petal^{-1})

Variety	**Fertilization mg**	**Chelated iron (mg L^{-1})**			**Variety * Fertilization**
		0	**25**	**50**	

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	liter 1				
V1	0	112.00 k	133.66 j	159.66 i	135.11 E
	50	171.33 h	185.33 g	207.33 e	188.00 D
	100	222.00 d	244.33 c	263.66 a	243.33 B
V2	0	113.33 k	135.66 j	163.66 i	137.55 E
	50	177.00 h	192.00 f	210.00 e	193.00 C
	100	227.66 d	250.66 b	267.33 a	248.55 A
Fertilization					
fertilization * chelated iron	0	112.66 i	134.66 h	161.66 g	136.33 C
	50	174.16 f	188.66 e	208.66 d	190.50 B
	100	224.83 c	247.50 b	265.50 a	245.94 A
Item					
item * chelated iron	V1	168.44 f	187.77 d	210.22 b	188.81 B
	V2	172.66 e	192.77 c	213.66 a	193.03 A
chelated iron		170.55 C	190.27 B	211.94 A	

The averages that take the same letter for each factor or overlap between them do not differ significantly (P≤ 0.05) according to Duncan's polynomial test.

Among the table (5). The V2 variety was significantly superior in the carotenoid content of the flower, as it gave 0.17 mg 100 gm dry weight, compared to the V1 variety, which gave the lowest percentage of 0.16 mg 100 g dry weight. Dry compared to the comparison treatment, which gave 0.11 mg 100 g dry weight. As for spraying with chelated iron, the results of the same table indicate the superiority of the spray treatment at the level of 50 mg L-1, which gave 0.18 mg 100 g dry weight compared to the comparison treatment, which gave the lowest weight of 0.15 mg 100 g dry weight.

The same table shows that there are significant differences for the binary interactions between the study factors. With regard to the interaction between cultivars and fertilization, the interaction between cultivar V2 and fertilization at the level of 100 mg L^{-1} was significantly outperformed, as it gave 0.23 mg of 100 gm of dry weight compared to the interaction between cultivar V1 with the non-fertilization treatment, which It gave 0.10 mg 100 gm dry weight. As for the interaction between the cultivar and spraying with chelated iron, it was significantly superior to the interaction between the V2 variety with spraying at the level 50 mg L^{-1}, as it gave 0.20 mg 100 gm dry weight compared to the interaction between the V1 variety with the no-spray treatment, which It gave 0.14 mg 100 g dry weight. Regarding the interaction between fertilization and spraying with chelated iron, the treatment of fertilization at the level of 100 mg L^{-1} was superior to spraying at the level of 50 mg L^{-1} as it gave 0.24 mg 100 g dry weight compared to the interaction of the control treatment, which gave 0.09 mg 100 g dry weight.

With regard to the triple interaction between the study factors, the interaction between the V2 variety with the fertilization at the level 100 mg L^{-1} and the spraying at the level 50 mg L^{-1}, which gave 0.26 mg 100 g dry weight, compared with the interaction of the V1 variety with the comparison treatment of fertilization and spraying, which gave 0.09 100 mg dry weight.

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Table (5). Effect of adding NPK compound fertilizer and spraying with chelated iron on the content of carotenoids for two cultivars of Jaafari (mg 100 g dry matter)

Variety	Fertilization mg liter 1	Chelated iron (mg L^{-1})			Variety * Fertilization
		0	25	50	
V1	0	0.09 l	0.11 jk	0.12 ij	0.10 F
	50	0.13 hi	0.16 fg	0.17 ef	0.15 D
	100	0.20 cd	0.22 bc	0.22 bc	0.21 B
V2	0	0.10 kl	2.05 ij	0.14 gh	0.11 E
	50	0.17 ef	0.18 ef	0.19 de	0.18 C
	100	0.21 bc	0.23 b	0.26 a	0.23 A
fertilization					
Fertilization * chelated iron	0	0.09 h	0.11 g	0.13 f	0.11 C
	50	0.15 e	0.17 d	0.18 d	0.17 B
	100	0.20 c	0.22 b	0.24 a	0.22 A
Item					
Item * chelated iron	V1	0.14 d	0.17 b	0.17 b	0.16 B
	V2	0.16 c	0.17 b	0.20 a	0.17 A
chelated iron		0.15 C	0.17 B	0.18 A	

Means that take the same letter for each factor or overlap between them do not differ significantly (P≤ 0.05) according to Duncan's polynomial test.

The results of the experiment showed that the use of two cultivars of the African marigold , Taishan (orange) and Taishan (yellow), led to significant differences in the characteristics of flowering growth. The content of total carotenoids in flowering inflorescences may be attributed to the difference in the genetic composition of the two cultivars.

The results of the experiment showed that the addition of NPK compound fertilizer led to a significant effect on the characteristics of flowering growth represented by the diameter of the inflorescence, the number of petals in the radial inflorescence and the content of total carotenoids in the flowering inflorescences. The reason for this increase may be attributed to the fact that both nitrogen and phosphorous lead to Nutrient absorption, stimulates blooming, and increases the diameter of the inflorescence in the plant, which may be due to the presence of potassium, which is a major active component in plant cells that contributes to cell division and enhances the ability of the plant cell to retain water and nutrients. The efficiency of photosynthesis and potassium plays an indirect role in the transport of carbohydrates and proteins to flowers during the stages of plant growth and the increase in the number of petals and improves the duration of the flower.

The results of the experiment also showed that spraying with chelated iron led to a significant effect on the characteristics of flowering growth represented by the diameter of the flowering inflorescence, the number of petals in the flowering inflorescence, and the content of total carotenoids in the flowering

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inflorescences, and the reason for this increase may be attributed to the fact that iron increased the efficiency of the process. Photosynthesis by regulating the growth of stomata, the content of pigments, and antioxidants and thus improving the vegetative growth of the plant (Xiao et al., 2021), which led to an improvement in the activity of the plant and the stock of carbohydrates, and the increase in the leaf area and the number of leaves of the plant led to an increase in the process of photosynthesis and raising the efficiency of the plant In early flowering and increase the flowering period of African marigold , and the reason for this superiority may be due to the role of iron in increasing the number of leaves and the content of chlorophyll leaves and the important role of iron in biosynthesis. Iron and carbohydrates in leaves, which promotes cell division and increases the activity of flower buds, and thus increases the number of petals. Mechanism (Abbass et al., 2013) when spraying chelated iron on calendula.

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