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ORIGINAL ARTICLE

EFFECT OF SILICON AND HUMIC ACID ON VEGETATIVE AND FLOWERING GROWTH TRAITS IN GAZANIA PLANT (*GAZANIA SPLENDENS*)

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Abstract: The experiment was conducted in the lath house of the College of Agriculture, Basrah University during the season 2020-2019, to study the effect of foliar spraying of silicon and humic acid and the interaction between them on the vegetative and flowering growth of *Gazania splendens*, the first factor is silicon and in four concentrations (0, 75, 150 and 300 mg.L^{-1}) and the second factor, humic acid, with four concentrations (0, 50, 100, 150 mg.L^{-1} . The experiment was conducted according to the completely randomized design (CRD) with three replicates. The results showed a significant increase in the vegetative growth traits of the plant when using silicon, represented by the height and diameter of the plant, the number of leaves, the number of offshoots, and the fresh weight of the vegetative growth (12.89 cm, 22.83 cm, 39.61 leaf. plant $^{-1}$, 7.54 offshoots. plant $^{-1}$ and 27.93 g) respectively. Also, there was an increase in the root growth as a result of the treatment with silicon, represented by the fresh weight of the root group and the length of the roots (10.07 g.plant^{-1} and 24.27 cm) respectively. The flowering traits of the plant, which are the number of flowers per plant, the length of the flower stalk, the flower diameter and the fresh weight of flower increased, respectively. The silicon concentration was highest at the concentration (300 mg.L^{-1}), which was (4.59 flower. plant $^{-1}$,10.87 cm, 9.37 cm and 3.87 g), respectively. Humic acid had a significant effect on the vegetative traits of the plant, and the two concentrations (100 and 150 mg.L^{-1}) gave the highest increase in plant height, plant diameter, number of leaves and fresh weight of the vegetative growth and the concentration of 100 mg.L^{-1} was given the highest values for the first three traits (12.77 cm, 38.33 cm and 39.40 leaf.plant^{-1}) respectively. While the highest value of the fresh weight of the vegetative was at a concentration of 150 mg.L^{-1} (27.32 g.plant^{-1}), the treatment with humic acid also improved the flowering traits and the treatment 100 mg.L^{-1} gave the highest average of the number of flowers, the length of the flower stalk , flower diameter and the fresh weight of the flowers (4.68 flowers. plant $^{-1}$, 11.37 cm, 9.38 cm and 3.69 g), and there was no significant effect of the treatment with humic acid on the traits of the number of offshoots and the fresh weight of the root system and the roots length, and there was a signific[illegible]nteraction between the treatments in many of the studied traits.

Key words: Gazania, Silicon, Humic acid.

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1. Introduction

Gazania splendens, also called treasure flower, belongs to the Asteraceae family, its original country in South Africa. It is widely cultivated as a garden plant, and it is a herbivorous plant with multicolored flowers. It flowers throughout the year. Its flowers flowering during the day and close at night and in cloudy weather, so they are not suitable for cutting flowers. The plant prefers sunny locations, tolerates drought and poor soils, and tolerates salinity. The plant is grown in various locations in the garden, such as flowerbeds and limbs. The plant is grown in various locations in the garden, such as flowerbeds and limbs, or as pots plant, and it can be grown in mixed with other flowering plants and Gazania is a perennial herbaceous plant that reaches a height of 15 cm and is considered one of the soil coverers, reproduces with seeds and offshoots [Badreya *et al.* (2105)].

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The leaves of the plant are linear, full-edged, the bottom surface is silver in color and is lobed at the beginning of their formation, the flowers are in beautiful multicolored inflorescences of 10-7 cm in diameter, characterized by the presence of black spots at the base of the orange radial flowers. The flowers are in beautiful multicoloured inflorescences of 10-7 cm in diameter, characterized by the presence of black spots at the base of the orange radial flowers. Silicon is one of the common chemical elements in nature and it is the second most common element on earth after oxygen and it represents 25% of the earth's crust [Epstein (1994)] and was considered an unnecessary element for plants, but in recent decades experiments have shown that silicon contributes to some improvement in Plant quality and its resistance to stress factors [Jarosz (2013)].

It increases plant resistance to fungal diseases and insect infections stated that plants equipped with silicon increased their resistance to fungal diseases, where the accumulation of silicon under the leaf cuticle limits the penetration of pathogens and access to internal tissues. Although silicon is not present in the list of essential elements for plant growth, it is one of the most beneficial elements and has important roles in many physiological processes, the most important of which are improving the efficiency of photosynthesis, increasing the efficiency of roots to absorb nutrients necessary for plant growth and development, reducing Na^+ toxicity, increasing the percentage of potassium to sodium K^+: Na^+, increasing the activity of antioxidant enzymes and reducing the toxicity of heavy elements [Adrees *et al.* (2015)]. Its beneficial properties include affecting the ionic balance in plants, reducing the toxic effect of high concentrations of manganese and iron, in addition to strengthening cell walls. The organic fertilizers represented by humic acid are one of the humic compounds resulting from the decomposition of organic matter at the present time, humic acid is used, which is considered one of the economic and commercial products with rapid effectiveness and harmless to humans and animals. Humic acid is used to reduce the harmful effect of mineral fertilizers on the soil, the main purpose of using humic acid is because it is a humic substance that is a nutrient for plants. Humic acid and humic substances have an effect on increasing the physiological activities of the plant and its reflection on growth and plant nutrient content, as well as that humic acids, inhibit the activity of the enzyme (IAA Oxidase), which leads to an increase in the activity of auxin (IAA), which plays a role in stimulating plant growth and roots. Also, humic acids improve the holding capacity of the elements in the soil by binding to sodium, which helps the plant withstand high concentrations of this element and protect against toxicity and osmotic problems [Stevenson (1994)]. The aim of this study is to know the effect of foliar spraying with silicon and humic acid and their interactions on plant development and the extent of the possibility of improving the vegetative and flowering traits of Gazania plants.

2. Materials and Methods

The study was conducted in the lath house of the College of Agriculture, Basra University for the period between October 2109 and May 2020 on the Gazania plant, where seedlings were brought from a nursery, which was cultivated in small pots with a diameter of 10 cm. Then it was transformed into plastic bags, 15 cm in diameter and 30 cm in length, containing an agricultural medium consisting of river soil and peat moss, at a percentage of 1:2, respectively, and each bag contains one plant, the experiment included a study of the effect of two factors, silicon and humic acid, on the vegetative and flowering traits of the Gazania plant. Spraying was added to the plants and the first factor was at four levels of silicon (0, 75, 150, 300 $mg.L^{-1}$) symbolized by S1, S2, S3 and S4, respectively. $Na_2SiO_3.5H_2O$ was added as sodium silicate and the second factor was at four levels of humic acid (0, 50, 100 and 150 $mg.L^{-1}$) and are symbolized by H1, H2, H3 and H4, respectively. The plants were sprayed with both factors to the degree of complete wetness using a hand sprayer with two sprayings at a difference of 14 days. The interaction between the two factors was sprayed first with silicon, and on the next day with humic acid. A factorial experiment was designed according to the completely randomized design (CRD) and with three replicates for each treatment. The arithmetic averages were compared using the lowest significant difference LSD under the probability level of 0.05. Using the Genstat program, the vegetative traits were measured which are plant height (cm), number of leaves ($leaf.plant^{-1}$), plant diameter (cm), the fresh weight of vegetative growth (g), the number of offshoots ($offshoots.\ plant^{-1}$), the fresh weight of the root system ($g.plant^{-1}$), the root length (cm), the number of flowers ($flowers.plant^{-1}$), the length of the flower stalk (cm), the flower diameter (cm), the fresh flower weight (g.flower^{-1}).

3. Results and Discussion

3.1 The effect of silicon

Traits of vegetative and root growth

The results in Table 1 showed that the treatment of Gazania plants with different concentrations of silicon led to a significant increase in most of the vegetative growth traits (plant height, plant diameter, number of leaves, number of offshoots and vegetative growth weight) compared to control treatment. The two concentrations 150 and 300 mg.L^{-1} silicon led to the highest average of plant height, which differed significantly from both control treatments and 75 mg.L^{-1}. Also, the plant diameter trait increased with the increase in the concentration of silicon, and the two concentrations 150 and 300 mg.L^{-1} increased the average of this trait, which differed significantly from the control treatment and 75 mg.L^{-1}, which did not differ between them. As for the trait of the number of leaves for each plant, it differed according to the different treatments. It is the highest average when concentration was 300 mg.L^{-1} at 39.61 (leaf.plant^{-1}) which differed significantly from the control treatment only and did not differ from the 75 and 150 mg.L^{-1}, which differed from the control treatment in this trait, As for the number of offshoots in the plant, it increased when treated with silicon at concentrations of 150 and 300 mg.L^{-1}, reaching (7.52 and 7.54), respectively, and they did not significantly differ between them and differed from the control treatment only. The fresh weight of vegetative growth was increased by using concentrations of 150 and 300 mg. L^{-1} silicon, where it reached (27.43 and 27.93 g), respectively, which differed from the two control treatments amounted to 75 mg.L^{-1}. There was also a significant increase in the fresh weight of the root system, using silicon at an concentration of 300 mg.L^{-1}, where it reached (10.07 grams), which differed from the two control treatments, and 75 mg.L^{-1}. As for the root length trait, its highest average was at the two concentrations 150 and 300 mg.L^{-1} silicon, which was 23.65 and 24.27 cm, respectively, which differed significantly from the two control treatments, and 75 mg. L^{-1} did not differ between them. This is consistent with what ***Debicz (2011)** found when using silicon at concentrations of 60, 120 and 180 mg.L^{-1} silicon on some ornamental plants. The higher concentration improved the growth of *Verbena hybrida* and led to an increase in plant height, plant diameter and number of branches and is also consistent with what Debicz *et al.* (2016) found when using silicon at concentrations of 120 and 180 mg. L^{-1}. It increased the number of leaves in Gazania plant. It increased by more than 83% at the concentration of 120 mg.L^{-1} and more than 73% at the concentration of 180 mg.L^{-1} compared to control treatment, and the concentration was 240 mg.L^{-1} increased plant diameter, plant height and number of leaves. Bayat *et al.* (2013) found that silicon used at a concentration of 100 mg.L^{-1} improved the vegetative and flowering growth of *Calendula officinalis* and was also consistent with Abd El Gayed (2019) when treating *Zinnia elegans* L. with silicon at a concentration of 400 and 500 mg.L^{-1} increased the fresh weight of the vegetative and root system. The improvement of vegetative growth traits using silicon may be due to an increase in the level of gibberellin in the plant, which was observed in the stems of the rice plant, where, gibberellin is responsible for stimulating plant growth, or perhaps it is the reason that some studies have indicated that silicon leads to an increase in the chlorophyll content of leaves, which encourages the synthesis of sugars that are used in plant growth [Mikiciuk and Mikiciuk (2008)], or the reason for improving the vegetative growth of the plant using silicon may be due to a significant increase in the growth of the root system, which increases the absorption of nutrients that contribute to the increase in growth [Debicz *et al.* (2016)]. The increase in the fresh weight of the vegetative and root growth may be due to a decrease in the average of transpiration, which leads to an increase in cell Turgor Pressure, in a study by Moon *et al.* (2008). The silicon-treated Chrysanthemum plants decreased the transpiration average and increased Turgor Pressure of their cells, which led to an increase in the fresh weight of the vegetative and root system.

The flowering growth traits

Table 1 showed that the silicon foliar spray has clear significant effects in the studied flowering growth traits and an increase in the number of flowers per plant, the flower stalk height and the diameter of the flower was observed with an increase in the fresh weight of the flower and that the three concentrations of 75,150 and 300 mg. L^{-1} increased the flowers number, which amounted to (4.10, 4.39 and 4.59 flower.plant^{-1}), respectively, which differed significantly from the control treatment and did not differ between them. As for the height of flower stalk, it was increased by using silicon, and the highest average for this trait was at a concentration of 300 mg.L^{-1}, which was (10.87 cm), which differed from the two control treatments and 75 mg.L^{-1}. As for the flower diameter trait, its highest average was at the two concentrations of 150 and 300 mg.L^{-1}, which were significantly different from the rest of the treatments, reaching (9.04 and 9.37 cm), respectively. While all the treatments differed from each other significantly in the trait of the fresh weight of flower, as an increase in the fresh weight of the flower was observed with an increase in the concentration of silicon, and the highest average of it was at the concentration 150 mg.L^{-1}, reaching 3.87 g. This is consistent with what ***Debicz and Katarzyna (2011)** found on the Xenia plant *Salvia farinacea*, where they observed an increase in the average diameter and number of flower at the higher concentration of silicon, which was 180 mg.L^{-1}. It also agrees with what reported by Debicz *et al*. (2016) and showed that the concentration of 180 mg.L^{-1} silicon caused an increase in the number of flowers of Gazania plants by 26%, Salvia farinacea by 96% and *Verbena hybrid* by 76% on the control treatment and increased the average diameter of verbena flowers, and the concentration was 240 mg.L^{-1} silicon increased diameter and number of flower in Gazania rigens. The reason for the improvement of the flowering characteristics using silicon may be due to the improvement of the vegetative growth of the plant (Table 1), which is reflected positively on the flowering traits, and the reason for the improvement of the flower growth traits by using silicon may be due to the increase in the level of gibberellin in the plant that was observed in the stems of the rice plant as gibberellin is responsible for inducing the plants to flower and increase the number of flowers or it may be the reason indicated by some studies that silicon increases the content of chlorophyll in leaves, which encourages the synthesis of sugars that are used in plant growth [Mikiciuk and Mikiciuk (2008)], or it may be the reason for improving the vegetative growth of the plant by using silicon to increase the growth of the root system, which increases the absorption of nutrients that contribute to increased growth [Bayat *et al*. (2013)].

3.2 The effect of humic acid

The traits of vegetative and root growth

The results in Table 2 showed that the treatment of the Gazania plant with different concentrations of humic acid led to a significant increase in most of the studied vegetative growth traits (plant height, plant diameter, number of leaves and fresh weight of the vegetative growth) as the treatment was given with humic acid at a concentration of 100 and 150 mg.L^{-1}, the highest average for the plant height traits (12.77 and 12.31 cm), respectively, which differed significantly from the two control treatments and 50 mg.L^{-1}, while the highest average of plant diameter at the treatment was 100 mg.L^{-1} (23.21 cm), which differed significantly from the rest of the treatments, as for the trait of the number of leaves in the plant, the highest average was at the concentration of 100 mg.L^{-1}, which differed from the control treatment only. The fresh weight of the vegetative growth increased with the increase of the humic concentration, which reached (27.23 and 27.32 g) at the concentrations of 100 and 150 mg.L^{-1}, respectively, which differed from the control treatment only, while the treatment with humic acid had no significant effect on the traits (number of offshoots, the fresh weight of the root system and the roots length). This agrees with Safana (2013) who found in a study to improve the vegetative growth traits of Dahlia hybrid when sprayed with different concentrations of humic acid, and also agrees with Al-Bayati and Ahmed (2019) who found in a study on the chrysanthemum *Calendula officinalis* L. treatment with humic acid resulted in improvement of some indicators of the vegetative growth of the plant and also agree with the study of Ahmad *et al.* (2019) of *Calendula officinalis* L. It observed a significant increase in the number of leaves per plant using humic acid at a concentration of 250 ml.L^{-1} compared to the higher concentrations as well as an increase in the average leaf length at concentration 750 ml.L^{-1}. The improvement in the vegetative growth traits of plants treated with humic acid may be due to the role of humic acid in increasing the physiological activities of the plant and its reflection in increasing growth and plant nutrient content and increasing the cytokinins and endogenous Auxin. And to contain humic acid on growth regulators that encourage plant growth, growth regulators extracted from humic acid, such as indole acetic acid, gibberellin

Table 1: The effect of silicon on some vegetative, root and flowering traits of Gazania plants.

Traits silicon	plant height (cm)	plant diameter (cm)	Number of leaves (leaves. plant^{-1})	Number of offshoots. plant^{-1} growth (g. plant^{-1})	The fresh weight. weight of vegetative (g.plant^{-1})	The fresh weight of the root system	The root length (cm)	the number of flowers. plant^{-1} (cm)	The length of the flower stalk	The flower diameter (cm)	The fresh flower weight (g. flower^{-1})
S1	10.63	19.57	34.16	6.14	25.40	9.17	21.90	3.64	8.98	8.27	2.48
S2	11.70	20.23	37.69	6.95	25.56	9.21	21.98	4.10	9.62	8.56	2.93
S3	12.30	22.25	38.57	7.52	27.43	9.64	23.65	4.39	10.38	9.04	3.67
S4	12.89	22.83	39.61	7.54	27.93	10.07	24.27	4.59	10.87	9.37	3.87
L.S.D	0.76	1.32	2.53	0.96	1.83	0.63	1.46	0.56	1.02	0.37	0.02

Table 2: The effect of humic acid on some vegetative, root and flowering traits of Gazania plant.

Traits humic acid	plant height (cm)	plant diameter (cm)	Number of leaves (leaves. plant^{-1})	Number of offshoots. plant^{-1} growth (g. plant^{-1})	The fresh weight. weight of vegetative (g.plant^{-1})	The fresh weight of the root system	The root length (cm)	the number of flowers. plant^{-1} (cm)	The length of the flower stalk	The flower diameter (cm)	The fresh flower weight (g. flower^{-1})
H1	10.88	19.78	36.45	6.02	25.18	9.10	21.74	2.53	8.63	8.28	2.40
H2	11.55	20.71	37.82	7.09	26.60	9.45	22.69	4.08	8.96	8.41	2.65
H3	12.77	23.30	39.40	7.60	27.23	9.87	23.89	4.68	11.37	9.38	3.69
H4	12.31	21.81	38.73	7.43	27.32	9.68	23.49	4.32	10.81	9.13	3.30
L.S.D	0.76	1.32	2.53	N.S.	1.83	N.S.	N.S.	0.56	1.02	0.37	0.02

and cytokinin, had a significant effect on plant growth [Atiyeh *et al.* (2002)], and humic acid is also a humic nutrient for plants. or as a result of the hormonal activity of humic acid on vegetative growth.

The traits of flowering growth

Table 2 shows that flowering traits were improved as a result of treating Gazania plants with humic acid, and a significant increase was observed in the number of flowers per plant, the flower stalk length, the flower stalk diameter, with an increase in the fresh weight of the flower, and the highest average of the number of flowers and the diameter of the flower was at a concentration of 100 mg.L^{-1} (4.68 flowers.plant^{-1} and 9.38 cm), respectively, which differed significantly from the two control treatments and 50 mg.L^{-1}. The flower stalk length was the highest average of it as concentration was 150 mg.L^{-1}, which reached (10.81 cm), which differed significantly from the two control treatments, and 50 mg.L^{-1}, while the highest average of fresh weight of flowers when treatment was 100 mg.L^{-1}, reaching (3.69 g) which differed significantly from the rest of the treatments, and this is agreed with Al-Bayati and Ahmed (2019) found when treating *Calendula officinalis* L. with humic acid, the higher concentration increased the number of flowers on the plant and also led to an increase in the length of the flower stalk and also agrees with Sendhilnathan *et al.* (2019) found that spraying *Tagetes erecta* L. plants with humic acid at a concentration of 1% led to a significant increase in the number of flowers per plant and in the average diameter and length of the flower stalk, The results are also in agrees with **Aslam *et al.* (2014)** who found a significant increase in the number of flowers, flower diameter and fresh weight of flowers when treating *Tagetes erecta* L. with humic acid. The reason for the improvement of the flowering traits of the plants treated with hydronic acid may be due to the improvement of the vegetative growth traits of the plant (Table 2), which leads to an increase in the photosynthesis products that improve the plant growth, and the reason for the improvement of the flowering growth by increasing the concentration of humic acid may be due to the positive effect of humic acid on absorption. Nutrients, increase photosynthesis and its metabolites and thus improve plant growth **[Aslam *et al.* (2014)]**.

Table 3: Interaction between silicon and humic acid in vegetative and root growth of Gazania plant.

		Humic acid			
Traits	**Silicon**	**H1**	**H2**	**H3**	**H4**
Plant height (cm)	S1	9.1	10.08	11.88	11.42
	S2	11.08	11.33	12.33	12.07
	S3	11.46	12.15	12.95	12.64
	S4	11.83	12.64	13.95	13.14
	L.S.D 5%	1.36			
Plant diameter (cm)	S1	17.83	18.92	22.11	19.42
	S2	18.92	20.16	23.21	21.45
	S3	20.29	21.44	24.05	23.22
	S4	22.08	22.33	23.86	23.17
	L.S.D 5%	2.11			
Number of leaves (leaf. plant $^{-1}$)	S1	34.16	36.21	38.33	37.44
	S2	36.79	37.43	38.74	37.83
	S3	36.58	37.50	40.88	39.32
	S4	38.29	40.15	39.66	40.35
	L.S.D 5%	5.96			
Number of offshoots.plant^{-1}	S1	4.38	5.88	7.18	7.12
	S2	6.36	6.77	7.39	7.31
	S3	6.58	7.85	7.88	7.79
	S4	6.79	7.88	7.96	7.53
	L.S.D 5%	1.85			
The fresh weight. weight of vegetative growth (g. plant^{-1})	S1	23.64	25.13	26.62	26.23
	S2	23.33	25.66	26.86	26.42
	S3	26.12	27.00	28.14	28.47
	S4	27.64	28.61	27.32	28.16
	L.S.D 5%	2.67			
The fresh weight of the root system (g.plant^{-1})	S1	8.54	9.07	9.61	9.47
	S2	8.43	9.17	9.74	9.53
	S3	9.44	9.56	9.81	9.77
	S4	9.99	10.03	10.33	9.96
	L.S.D 5%	1.36			
The root length (cm)	S1	20.40	21.66	22.95	22.62
	S2	20.14	21.82	23.11	22.85
	S3	22.56	23.17	24.68	24.19
	S4	23.87	24.11	24.83	24.30
	L.S.D 5%	2.17			

3.3 Effect of interaction between Silicon and Humic Acid

The traits of vegetative and root growth

Table 3 showed that the vegetative and root growth traits were significantly affected by treatment with silicon and humic acid together, and the highest average of traits (plant height, the number of offshoots, the fresh weight of the root system, and the length of the roots, which amounted to (13.95 cm, 7.96 leaf.plant^{-1}, 10.33 g and 24.83 cm), respectively at a concentration of 300 mg l-1 silicon and 100 mg l-1 humic acid, which differed significantly from the control treatment and some interactions between silicon and humic acid. As for the traits of plant diameter, number of leaves and fresh weight of the vegetative, which were (24.05 cm, 40.88 leaf.plant^{-1} and 28.14 g.plant^{-1}), respectively, at a concentration of 150 mg.L^{-1} silicon and 100 mg.L^{-1} humic acid, which differed significantly from the control treatment and some other interactions between the study factors, and the reason for the role of silicon in improving the traits of vegetative growth may be to increase the level of gibberellin in the plant when treated with silicon, as gibberellin is responsible for inducing

Table 4: The interaction between silicon and humic acid in the flowering growth of Gazania plant.

		Humic acid			
Traits	**Silicon**	**H1**	**H2**	**H3**	**H4**
The number of flowers. plant^{-1}	S1	2.58	3.49	4.33	4.16
	S2	3.41	4.24	4.56	4.22
	S3	4.00	4.32	4.88	4.37
	S4	4.16	4.72	4.97	4.54
	L.S.D 5%	1.96			
The length of the flower stalk (cm)	S1	7.42	7.79	10.75	9.67
	S2	8.41	8.66	11.26	10.16
	S3	9.17	9.53	11.38	11.46
	S4	9.54	9.87	12.11	11.97
	L.S.D 5%	2.35			
The flower diameter (cm)	S1	7.66	8.04	8.75	8.63
	S2	8.00	8.14	9.11	8.90
	S3	8.62	8.54	9.63	9.37
	S4	8.87	8.92	10.06	9.65
	L.S.D 5%	1.31			
The fresh flower weight (g. flower^{-1})	S1	2.33	2.48	2.80	2.71
	S2	2.96	3.04	3.43	2.30
	S3	3.00	3.67	4.06	3.97
	S4	3.07	3.70	4.49	4.23
	L.S.D 5%	0.87			

the plant to grow, or it may be the reason for improving the vegetative growth of the plant by using silicon to a significant increase in the growth of the root system, which increases the absorption of nutrients that contribute to the increase in growth [Dêbicz *et al.* (2016)], likewise, the role of humic acid in improving the growth traits of the plants treated with it, and that the improvement in the vegetative growth traits of the plants treated with humic acid may be due to the role of humic acid in increasing the plant's physiological activities and its reflection in increasing the growth and plant content of nutrients and increasing cytokine and endogenous Auxin.

The traits of flowering growth

The results in Table 4 showed that the interaction between the two study factors had a significant effect on all the traits of flowering growth (number of flowers, length of flower stalk , flower diameter and fresh weight of flowers) and the highest average of them when treatment was at a concentration of 300 mg.L^{-1} silicon and 100 mg.L^{-1} humic acid and the effect of silicon in improving flowering traits may be the reason that some studies have indicated that silicon leads to an increase in the content of leaves of chlorophyll, which encourages the synthesis of sugars that are used in plant growth, which is reflected in the traits of flowers [Mikiciuk and Mikiciuk (2008)], likewise, the role of humic acid, which may be the reason for the improvement of the flowering traits of plants treated with humic acid, may be due to the improvement of the vegetative growth traits (Table 2), which leads to an increase in photosynthesis products that improve plant growth, and the reason for the improvement of flower growth may be due to an increase in the concentration of humic acid. For the positive effect of humic acid on nutrient absorption, increased photosynthesis and its metabolites, and thus improved plant growth **[*Aslam *et al.* (2014)]**.

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