Pak. j. life soc. Sci. (2024), 22(1): 3733-3744 E-ISSN: 2221-7630;P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2024-22.1.00273

RESEARCH ARTICLE

Effect of Some Treatments on the Vegetative Growth Characteristics of Two Varieties of *Hyacinthus Orientalis* L Plant

Suleiman Salem Suleiman[1], Alaa Hashim Younis Altaee[2]

[1,2]Department of Horticulture and Landscape Engineering, College of Agriculture and Forestry, University of Mosul, Iraq

ARTICLE INFO

Received: May 22, 2024

Accepted: Jul 6, 2024

Keywords

Vegetative growth

Hyacinthus orientalis. L.

Flowering growth

Carnegie

***Corresponding Author:**

sulaiman.22agp81@student.uomosul.edu.iq

dr_alaa_altaee@uomosul.edu.iq

ABSTRACT

The experiment was carried out in the wooden canopy of the Department of Horticulture and Landscape Engineering/College of Agriculture and Forestry/University of Mosul during the agricultural season (2023-2024). To study the effect of spraying with different concentrations of calcium chloride (0, 500, 1000) mg L-1 and spraying with gibberellic acid at concentrations of (0, 100, 200) mg L-1 and the interaction between them on vegetative and flowering growth and the yield of bulbs and follicles for two types of bulbs of the hyacinth plant, Hyacinthus orientalis. L. They are ″Carnegie‟ with white flowers and ″Fondant″ with pink flowers. The study was carried out using a factorial experiment in a randomized complete block design (RCBD) in split plots, with three replicates and 8 plants per replicate. The results indicated that the white variety recorded the largest plant height, 25,261 cm, and the largest values in the average leaf length per plant, 21,382 cm, and the leaf area, 200,019 cm2, while the pink variety recorded the largest values in the number of leaves per plant, 6,634 leaves per plant, and the dry weight of the leaves, 4,599 gm per plant.

INTRODUCTION

The scientific name of the Hyacinthus plant is *Hyacinthus orientalis* L. It belongs to the lily family Liliaceae, the Hyacinthaceae family, the genus Hyacinthus, are called hyacinth bulbs and are also called hyacinth bulbs (Khattab and Imad al-Din, 1988). The regions of the Mediterranean basin and Central Asia in Iraq, Syria, Asia Minor, and Greece are considered the original homeland of the plant (Al-Sultan et al., 1992), as well as western Central Asia (Rees, 1972) When he moved to Europe, the Netherlands became the producer of (95%) of global production. In another statistic for the year 2014, the percentage of demand for its cut flowers globally reached 0.5% (Anonymous, 2014). It is one of the true ornamental bulbs that have been planted since ancient times and the name of the species (orientalis) means east or sunrise in Arabic (Abu Dahab, 1992). It is considered one of the most resistant types of bulbs to cold and freezing, but it is affected by high temperatures. The importance of the plant is due to its cultivation in flowering pots, or its cultivation in ponds in private and public gardens (Al-Shayeb, 2005). and Abu Zaid, 2002) Calcium chloride is one of the important compounds in regulating growth and development in plants, in addition to its

inclusion in the formation of the cell wall. It also affects the integrity of the cell wall and is the last barrier before cell separation (Hepler, 2005). It was also found that treatment with calcium chloride caused an increase in various vegetative and flowering growth traits (Nasirkhan et al., 2012). Ca++ is a universal second messenger and has long been considered the second messenger in many signaling chains, including cell wall defense signals (Sun, 2009). Calcium has an important role in preserving the structure of the plant cell and making it strong and cohesive by achieving stability and consistency of the cell membrane. Hence, the role of calcium in improving the quality standards of flowers during the stages of vegetative and flowering growth is evident. Calcium works to mitigate the effects of salt stress on the plant and increase the hardness and thickness of the cell wall and strengthen it. The floral stem, maintaining the water balance in the flower, preventing the flower neck from bending and not fully opening the flower, reducing the rate of senescence and prolonging the life of the flower (White and Broadley, 2003; Hepler, 2005; Dodd et al., 2010).

Known as gibberellic acid GA_3 plays an active role in the elongation of stems, petioles, inflorescences, and flower development (Hsu et al., 2008). Treatment with gibberellic acid plays an important role in promoting plant development such as early and induced flowering, increasing plant height, number of leaves, chlorophyll content, yield and quality in various flowering crops such as Lilium, Tulip, Claudius and Freesia (Emami et al., 2011; Sure et al., 2012; Kumar et al. 2013). Gibberellins represent a group of plant hormones that stimulate growth. The physiological effects of gibberellins are attributed to their control of enzymatic activity and their activation of metabolic processes such as increasing carbohydrates, cell division and elongation, and increasing or decreasing fruit set and ripening (Al-Khafaji, 2014). It plays a role in flowering through its combination with Anthesin and the production of the flowering hormone Florogen, which has a role in stimulating flowering (Hassanein et al., 2010). Gibberellin also stimulates seed germination, fruit set, and sex determination, as well as regulates the transition from the juvenile stage to the adult stage (Hedden and Thomas, 2006).

In the study conducted by Chalabi and Zainab (2016) on five varieties of jasmine bulbs (Fondante, Marie, Splendid, Carnegie, (Amsterdam) stated that the five cultivars differed significantly among themselves in all floral and vegetative traits, where the cultivar (Fondante) and the plants of the cultivar (Amsterdam) were distinguished by their need for the least number of days to open the first floret compared to the other cultivars, and they attributed the reason to Difference in genetic characteristics: There are early flowering varieties and late flowering varieties. They also explained that the variety (Fondante) was significantly distinguished in the shortest time for the first flower to open (122) days and the length of the flower inflorescence (7.433) cm over all the varieties subject of the study. It also showed a significant difference among them in The number of florets per plant, and in the experiment conducted by Al-Fakhry (2023) with the aim of studying the effect of spraying with different concentrations of calcium chloride (0, 500, 1000) mg L^{-1} on the vegetative and flowering growth and vine yield of two varieties of Gladiolus hybrid L The Nova lux variety with yellow flowers and the Trader Lux variety with red flowers found that treatment with calcium chloride at both concentrations of 500 and 1000 mg L^{-1} led to a significant increase in all the traits studied. In a study conducted by Al-Amin and Saeed (2020), they found that spraying with acid Gibberellic acid had a significant effect on most of the vegetative and floral traits of the Iris plant *Iris Hollandica.* Spraying at a concentration of 100 mg L^{-1} resulted in

the largest flower diameter (12.07) cm, while spraying at a concentration of 200 mg L^{-1} gave the highest number of leaves (5.38) $leaf^{-1}$, the longest leaf length (130.18) cm and the longest stand. Pink (68.01) cm, and the longest vase lived (9.77) days.

MATERIALS AND METHODS

The experiment was carried out inside the wooden canopy of the Department of Horticulture and Landscape Engineering/College of Agriculture and Forestry/University of Mosul, during the period from November 1, 2023 to June 1, 2024, in order to study the effect of spraying with three levels of calcium chloride (CaCl2) is (0, 500, 1000) mg L-1 and three levels of gibberellic acid (GA3) are (0, 100, 200) mg L-1 and the interaction between them in the characteristics of vegetative and flowering growth and the yield of bulbs and bulbs for two types of jasmine bulbs. *Hyacinthus orientalis* L..

Studied attributes

Number of days required for emergence (day):I calculated the number of days from planting until the plants emerged above the soil surface.

Percentage of emergence:

The percentage of emergence was calc

Number of sprouting plants

100 X

Plant Height (cm): The plant height was measured from the soil surface to the highest point of the flower stalk using a measuring tape.

Average longest leaves (cm): It was calculated Average leaf lengths (cm) for each plant.

Number of leaves (leaf-1): Make a calculation The total number of leaves of the plant when the flowers are harvested.

Plant leaf area (cm2): It was calculated by taking (9) discs with an area of (1) cm^2 using a cork puncher Cork Bores from the leaves, then the discs and the total leaves were dried in an electric oven at a temperature of (72)°C for a period of (72) hours, until the weight was stable. Then the leaf area of the plant was calculated using a proportional method based on the dry weight of the discs and leaves only, according to what was indicated. Muhammad (1985).

Dry weight of leaves (g): It was calculated Using a scale Electronic after complete drying of leaves on plants.

RESULTS AND DISCUSSION

Number of days required for emergence (day):

The results of Table (1), regarding the number of days required for vegetative growth to emerge, indicate that there are significant differences between the two varieties in the period required for emergence, as the pink variety recorded Fondant had the shortest days to emerge, reaching 30 days, while the white variety Carnegie recorded more days, reaching 35 days.

Table (1): Number of days required for emergence (day) for two varieties *Hyacinthus orientalis* L..

Items	Number of days required for emergence (day)
Carnegie	35 a
Fondant	30 b

*Values with similar letters for each factor are not significantly different according to Duncan's multinomial test under the 5% probability level.

Emergence percentage:

It appeared from the data in Table (2) that the percentage of emergence was 100% in all plants of the white variety. Carnegie and the pink variety Fondant.

Table (2):.Percentage of emergence of two varieties of *Hyacinthus orientalis* L

Items	Percentage of emergence
Carnegie	**100%**
Fondant	**100%**

Plant Height(cm):

The results of the statistical analysis in Table (3) showed that there were significant differences between the two varieties in the characteristics of plant height, where the white variety plants were recorded Carnegie The highest height reached 25.261 cm, while plants of the pink variety were recorded Fondant The height reached 24,044 cm, and the spraying with calcium chloride at a concentration1000 mg L-1 led to a significant increase in the value of this trait, reaching 25.868 cm compared to 23.360 cm in the comparison treatment. It also became clear that spraying with gibberellic acid at concentrations of 100 and 200 mg L-1 resulted in a significant, direct increase in the plant height with The increase in concentration reached 24.944 and 26.840 cm, respectively, compared to 22.173 cm for the control plants. The results of the double interaction between the variety and calcium chloride showed the largest values for plant height when sprayed with calcium chloride, as it reached 26.763 cm for the plants of the white variety, and this value decreased to 22.896 cm for the plants of the pink variety not treated with calcium chloride. The results of the double interaction between the variety and gibberellic acid also showed As the highest I rate For the height of the plant and up to 27,083 cm for white variety plants, while it decreased to 21,438 cm for the unpleasant pink category plants, the treatment of Gabrik acid, and the results of the interference between the Calcium Chloe and the Jappers, indicated that the highest values were 28.020 cm compared to the comparison treatment where it was 18.603 cm. In summary of the above, the results of the triple interaction of the factors subject of the study showed that when spraying the Carnegie white variety plants with calcium chloride at a concentration of 1000 mg L-1, mixed with spraying with gibberellic acid at a concentration of 200 mg L-1, it resulted in giving the highest significant values, reaching 28.875 cm, and

this value decreased to the lowest, reaching 17.897 cm for Pink Fondant plants not treated with calcium chloride and gibberellic acid.

Table (3): The effect of calcium chloride and gibberellic acid and their interactions on plant height at flowering (cm) for two varieties of the *Hyacinthus orientalis* L.

Items	Calcium chloride (mg l-1)	Gibberellic acid concentrations (mg L-1)			Overlapping of items X Calcium chloride	Item response
		0	100	200		
Carnegie White	0	19.310j	25.666C D e	26.500b c	**23.825C**	**25.261a**
	500	24.500g h	25.375D E F	25.875Cde	**25.194B**	
	1000	25.083e f g	26.333b c d	28.875a	**26.763a**	
Fondant Pink	0	17.897K	24.500f g h	26.291bcd	**22.896D**	**24.044B**
	500	22.875i	23.583h i	26.333bcd	**24.263b c**	
	1000	23.541h i	24.208g h	27.166B	**24.972B**	
Overlapping of items X Gibberellic acid	the White	22.908D	25.791B	27.083a	**Chloride effect Calcium**	
	Pink	21.438e	24.097C	26.597B		
Calcium chloride interference X Gibberellic acid	0	18.603g	25.083cd	26.395B	**23.360C**	
	500	23.604f	24.479d e	26.104B	**24.729B**	
	1000	24.312e	25.270C	28.020a	**25.868a**	
Effect of gibberellic acid		22.173C	24.944B	26.840a		

*Values with similar letters for each factor or their interactions individually are not significantly different according to Duncan's multinomial test under probability level 5..%

Average leaf lengths (cm):

Based on the data of the statistical analysis results in Table (4), especially in terms of average leaf lengths, it was noted that the varieties differed significantly among themselves, as the white variety plants out performed Carnegie Significantly, it reached 21.382 cm compared to 20.185 cm for the pink variety .Fondant While we find that spraying with calcium chloride at a concentration1000 mg L^{-1} led to a significant increase in the average leaf length, which reached 22.827 cm, compared to 18,244 cm for the comparison treatment. It was also found that spraying with gibberellic acid at a concentration of 200 mg L^{-1} led to a significant increase in the average leaf length, which reached 23,121 cm. In comparison to 17.956 cm for the comparison treatment. The results of the interaction between the variety and calcium chloride indicated that the highest values for the average length of leaves were obtained when the plants were sprayed with calcium chloride, and it reached 23.662 cm for the plants of the white variety treated with a concentration of 1000 mg L^{-1} of calcium chloride. This value decreased to 17.470 cm for the plants of the non-pink variety. Treated with calcium chloride. We also notice from the results of the interaction between the variety and gibberellic acid that the largest values in the average leaf length reached 23.902 cm for the

plants of the white variety treated with a concentration of 200 mg L^{-1} of gibberellic acid, while it decreased to 17.379 cm for the plants of the pink variety not treated with gibberellic acid For you The results of the interaction between calcium chloride and gibberellic acid also showed that the highest values reached 25,662 cm compared to the comparison treatment, which reached 15,250 cm. It became clear through the results of the triple interaction of factors that spraying the white variety plants with calcium chloride at a concentration of 1000 mg L^{-1}, interspersed with spraying with gibberellic acid at a concentration of 200 mg L^{-1}, gave the highest significant values, reaching 26.958 cm, while this value decreased to a minimum of 14.375 cm for the pink variety plants. Not treated with calcium chloride and gibberellic acid.

schedule (4): effect of calcium chloride and gibberellic acid and their interactions on the average length of leaves at flowers (cm) of two varieties of the *Hyacinthus orientalis* L.

Items	Calcium chloride (mg l-1)	Gibberellic acid concentration (mg L-1)			Overlapping of items X chloride Calcium	Item response
		0	100	200		
Carnegie white	0	16.125H	19.430And g	21.503d e	19.019C	21.382a
	500	19.196f g	21.958de	23.245b c	21.466B	
	1000	20.278ef	23.750B	26.958a	23.662a	
Fondant pink	0	14.375i	18.465g	19.570f g	17.470D	20.185B
	500	18.318g	21.875cd	23.083b c	21.092B	
	1000	19.445f g	22.166cd	24.366B	21.992B	
Overlapping of items X Gibberellic acid	the White	18.533D	21.712B	23.902a	impact Calcium chloride	
	Pink	17.379e	20.835C	22.340B		
Calcium chloride interference X Gibberellic acid	0	15.250g	18.947ef	20.536D	18.244C	
	500	18.757f	21.916C	23.164B	21.279B	
	1000	19.861d e	22.958B	25.662a	22.827a	
Effect of gibberellic acid		**17.956C**	**21.274B**	**23.121a**		

*Values with similar letters for each factor or their interactions individually are not significantly different according to Duncan's multinomial test under the 5% probability level.

Number of leaves (plant leaf^{-1}):

The data in Table (5) indicated that there was a significant difference between the two varieties in the number of leaves, as the pink variety plants were recorded Fondant had the largest significant values, reaching 6.634 leaves^{-1} compared to 5.974 leaves of the Carnegie white variety. It was found that spraying with calcium chloride at a concentration of 1000 mg L^{-1} led to the highest values, reaching 6.798 leaves^{-1} compared to 5.794 leaves^{-1}. For the comparison treatment, it was also found that spraying with gibberellic acid at a concentration of 200 mg L^{-1} led to the highest values, reaching 6.937 leaves^{-1} compared to 5.718 leaves^{-1} for the comparison treatment. It is noted from the results of the binary interaction between the variety and calcium chloride that the largest values for the number of leaves were obtained when the plants were sprayed with calcium chloride, and it

amounted to 7,125 leaves per plant^{-1} for the plants of the pink variety treated with a concentration of 1,000 mg L^{-1} of calcium chloride, which was reduced to 5,463 leaves per plant. For the white variety plants not treated with calcium chloride, it was also observed that the highest values were recorded in the number of leaves, which amounted to 7,305 leaves per plant^{-1} for the pink variety plants treated with a concentration of 200 mg L^{-1} of gibberellic acid, while it decreased to 5,394 leaves per plant^{-1} for the white variety plants not treated with acid. Gibberellic acid, and you also showed the results of the interaction between calcium chloride and gibberellic acid when plants were sprayed with calcium chloride at a concentration of 1,000 mg L^{-1} overlapping with spraying with gibberellic acid at a concentration of 200 mg L^{-1}. The highest significant values were recorded, reaching 7,520 leaves^{-1}, while the lowest values were recorded at 5,154 leaves. Plant^{-1} for comparison plants. The results of the triple interaction of the factors subject of the study showed that spraying the plants of the pink variety Fondant with calcium chloride at a concentration of 1000 mg L^{-1}, interspersed with spraying with gibberellic acid at a concentration of 200 mg L^{-1}, gave the highest significant values, reaching 7,958 leaves^{-1}, while these values decreased to the lowest and reached 4,683 leaves $^{-1}$ for Carnegie white plants not treated with calcium chloride and gibberellic acid.

Table (5): The effect of calcium chloride and gibberellic acid and their interactions on the number of leaves at flowering (plant leaf-1) of two varieties of the *Hyacinthus orientalis* L.

Items	Calcium chloride (mg l-1)	Gibberellic acid concentration (mg L-1)			Overlapping of items X Calcium chloride	Item response
		0	100	200		
Carnegie white	0	4.683i	5.416H	6.291E f G	5.463e	5.974B
	500	5.500H	6.125f g	6.333d g	5.986D	
	1000	6.000g	6.333d g	7.083B	6.472b c	
Fondant pink	0	5.625H	6.083g	6.666c d	6.125c d	6.634a
	500	6.041g	6.625C D E	7.291B	6.652B	
	1000	6.458D E F	6.958b c	7.958a	7.125a	
Overlapping of items X Gibberellic acid	the White	5.394D	5.958C	6.569B	impact Calcium chloride	
	Pink	6.041C	6.555B	7.305a		
Calcium chloride interference X Gibberellic acid	0	5.154g	5.750f	6.479cd	5.794C	
	500	5.770f	6.375d e	6.812B	6.319B	
	1000	6.229e	6.645b c	7.520a	6.798a	
Effect of gibberellic acid		**5.718C**	**6.256B**	**6.937a**		

*Values with similar letters for each factor or their interactions individually are not significantly different according to Duncan's multinomial test under the 5% probability level.

Plant leaf area (cm^2):

We notice from the data in Table (6) that there is a significant difference between the two varieties of jasmine plants in the leaf area of the plant, where the white variety plants were recorded Carnegie had the largest significant values, reaching 200,019 cm^2 plant-1,

compared to 182,572 cm^2 $plants^{-1}$ for the plants of the pink Fondant variety. Spraying with calcium chloride at a concentration of 1000 mg L^{-1} gave the largest significant values in leaf area, reaching 223,444 cm^2 $plants^{-1}$, compared to 153,291 cm^2. Plant-1 for the comparison treatment. We also find that spraying with gibberellic acid at a concentration of 200 mg L^{-1} led to obtaining the highest significant values, reaching 218.312 cm^2 plant-1 compared to 160.909 cm2 plant-1 for the comparison treatment. The results of the binary interaction between the variety and calcium chloride showed that the highest significant values for the leaf area trait were obtained when the plants were sprayed with calcium chloride, which amounted to 241.545 cm^2 for the white variety plants treated with a concentration of 1000 mg L^{-1} of calcium chloride and decreased to 143.510 cm^2 $plant^{-1}$ for the plants The non-pink variety Treated with calcium chloride, the largest values recorded in leaf area were 228,621 cm2 plant-1 for the white variety plants that were sprayed with a concentration of 200 mg L^{-1} of gibberellic acid, while it was reduced to 151,602 cm^2 $plant^{-1}$ for the pink variety plants not treated with gibberellic acid. Also, one of the results of the interaction between calcium chloride and gibberellic acid is that when plants were sprayed with calcium chloride at a concentration of 1000 mg L^{-1}, mixed with spraying with gibberellic acid at a concentration of 200 mg L^{-1}, this led to obtaining the largest significant values, reaching 249.698 cm2 $plant^{-1}$, while this value decreased. It reached the lowest level and reached 114,460 cm^2 plant-1 for comparison plants. In general, it can be said that the results in the three-way interaction of the factors under study showed that spraying Carnegie white cultivar plants with calcium chloride at a concentration of 1000 mg L^{-1}, interspersed with spraying with gibberellic acid at a concentration of 200 mg L^{-1}, led to reaching the highest significant values, which amounted to 267.616 cm2 $plant^{-1}$. While this value decreased to the lowest and reached 101.653 cm2 $plant^{-1}$ for the pink Fondant plants not treated with calcium chloride and gibberellic acid.

Table (6): The effect of calcium chloride and gibberellic acid and their interactions on the leaf area of the plant at flowering (cm2) for two varieties of the *Hyacinthus orientalis* L.

Items	Calcium chloride (mg l-1)	Gibberellic acid concentration (mg L-1)			Overlapping of items X Calcium chloride	Item response
		0	100	200		
Carnegie white	0	127.266H	163.774f g	198.175D	163.072C	200.019a
	500	161.359f g	204.887D	220.073C	195.440B	
	1000	222.020C	235,000B	267.616a	241.545a	
Fondant pink	0	101.653i	157.020g	171.857ef	143.510D	182.572B
	500	171.976ef	204.247D	220.370C	198.864B	
	1000	181.177e	203.071D	231.780b c	205.343B	
Overlapping of items X Gibberellic acid	the White	170.215D	201.220B	228.621a	impact Calcium chloride	
	Pink	151.602e	188.113C	208.002B		
Calcium chloride interference X Gibberellic acid	0	114.460f	160.397e	185.016D	153.291C	
	500	166.668e	204.567C	220.221B	197.152B	
	1000	201.599C	219.036B	249.698a	223.444a	
Effect of gibberellic acid		160.909C	194.667B	218.312a		

*Values with similar letters for each factor or their interactions individually are not significantly different according to Duncan's multinomial test under the 5% probability level.

Dry weight of leaves (g):

The results in Table (7) showed that there were significant differences between the two varieties of jasmine plants in the dry weight of the leaves, where the plants of the pink variety were recorded Fondant had the highest moral values, reaching 4.599 gm plant^{-1} compared to 4.360 gm plant^{-1} for plants of the white variety Carnegie. On the other hand, spraying with calcium chloride at a concentration of 1000 mg l^{-1} led to obtaining the highest values, reaching 4.947 gm plant^{-1} compared to 3.918 gm plant^{-1} for the comparison treatment, and when spraying with gibberellic acid at a concentration of 200 mg L^{-1}, the highest significant values were obtained, reaching 5.299 gm plant-1 compared to 3.679 gm plant^{-1} for the plants of the comparison treatment. The results of the bilateral interference between the class and calcium chloride were obtained that the largest values of the dry weight of the leaves were obtained when the plants were sprinkled with calcium, where you were 5.060 g^{-1} for pink plants, the treatment of 1000 millimeters^{-1} mg^{-1} from the calcium 2 g is a plant $^{-1}$ for the white variety plants not treated with calcium chloride, and it was also found that the highest values in the dry weight of the leaves that were recorded amounted to 5.452 gm plant-1 for the pink variety plants that were sprayed with a concentration of 200 mg l^{-1} of gibberellic acid, while it decreased to 3.586 gm plant. $^{-1}$

Table (7): The effect of calcium chloride and gibberellic acid and their interactions on the dry weight of leaves (gm plant-1) of two varieties of the *Hyacinthus orientalis* L

Items	Calcium chloride (mg l-1)	Gibberellic acid concentration (mg L-1)			Overlapping of items X Calcium chloride	Response item
		0	100	200		
Carnegie white	0	3.206n	3.943ig	4.046h i	3.732f	4.360B
	500	3.720kl	4.356g	5.463D	4.513D	
	1000	3.833jK	4.743e	5.930B	4.835B	
Fondant pink	0	3.530M	4.340g	4.446g	4.105e	4.599a
	500	3.690l	4.590f	5.620C	4.633C	
	1000	4.096H	4.793e	6.290a	5.060a	
Overlapping of items X Gibberellic acid	the White	3.586f	4.347D	5.146B	impact Calcium chloride	
	Pink	3.772e	4.574C	5.452a		
Calcium chloride interference X Gibberellic acid	0	3.368i	4.141f	4.246e	3.918C	
	500	3.705H	4.473D	5.541B	4.573B	
	1000	3.965g	4.768C	6.110a	4.947a	
Effect of gibberellic acid		**3.679C**	**4.461B**	**5.299a**		

*Values with similar letters for each factor or their interactions individually are not significantly different according to Duncan's multinomial test under the 5% probability level.

For the white variety plants not treated with gibberellic acid, and we note in the data on the results of the interaction between calcium chloride and gibberellic acid that it was found that when spraying the plants with calcium chloride at a concentration of 1000 mg L^{-1} mixed with spraying with gibberellic acid at a concentration of 200 mg L^{-1}, it gave the largest significant values, reaching 6.110 gm $plant^{-1}$, while this value decreased to the lowest and reached 3.368 gm $plant^{-1}$ for comparison plants. It became clear through studying the results of the triple interaction of the studied factors that spraying the plants of the pink variety Fondant with calcium chloride at a concentration of 1000 mg L^{-1}, interspersed with spraying with gibberellic acid at a concentration of 200 mg L^{-1}, gave the highest significant

values, reaching 6.290 gm L^{-1}, while we find that these The value decreased to its lowest and reached 3.206 gm plant-1 for Carnegie white cultivar plants not treated with calcium chloride and gibberellic acid.

Calcium chloride is one of the important compounds in regulating growth and development in plants, in addition to its inclusion in the formation of the cell wall and also affects the integrity of the cell wall and is the last barrier before cell separation (Hepler, 2005). It was also found that treatment with calcium chloride caused an increase in various vegetative and flowering growth characteristics (Nasirkhan et al., (2012), and Ca++ is a universal second messenger and has long been considered the second messenger in many signaling chains, including cell wall defense signals (Sun, 2009). Calcium has an important role in preserving the structure of the plant cell and making it strong and cohesive by achieving stability and consistency of the cell membrane. Hence, the role of calcium in improving the quality standards of flowers during the stages of vegetative and flowering growth is evident. Calcium works to mitigate the effects of salt stress on the plant and increase the hardness and thickness of the cell wall and strengthen it. The floral stem, maintaining the water balance in the flower, preventing the flower neck from bending and not fully opening the flower, reducing the rate of senescence and prolonging the flower life (White and Broadley, 2003; Hepler, 2005; Dodd et al., 2010).

Known as gibberellic acid GA_3 plays an active role in the elongation of stems, petioles, inflorescences, and flower development (Hsu et al., 2008). Treatment with gibberellic acid plays an important role in enhancing plant development such as early and induced flowering, increasing plant height, number of leaves, chlorophyll content, yield and quality in various flowering crops such as lilyum, tulip, cladiolus and freesia (Emami et al., 2011; Sure et al., 2012; Kumar et al., 2013). Gibberellins represent a group of plant hormones that stimulate growth. The physiological effects of gibberellins are attributed to their control of enzymatic activity and their activation of metabolic processes such as increasing carbohydrates, cell division and elongation, and increasing or decreasing fruit set and ripening (Al-Khafaji, 2014). It plays a role in flowering through its combination with Anthesin and the production of the flowering hormone Florogen, which has a role in stimulating flowering (Hassanein et al., 2010). Gibberellin also stimulates seed germination, fruit set, and sex determination, as

well as regulates the transition from the juvenile stage to the adult stage (Hedden and Thomas, 2006).

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