

THE EFFECT OF SOME TREATMENTS ON THE FLOWER GROWTH CHARACTERISTICS OF TWO VARIETIES OF *HYACINTHUS ORIENTALIS* L. PLANT

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ABSTRACT

The experiment was carried out in the wooden canopy of the Department of Horticulture and Landscape Design/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 bulbs 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 implemented using a factorial experiment in a randomized complete block design (R.C.B.D.) in split plots With three replicates and 8 plants per replicate. The results indicated that the white variety recorded the largest values in the fresh weight of the flower bud, 42.799 grams, and the largest length of the flower bud, 20.935 cm, while the plants of the pink variety recorded the fewest days in the period required for the flower bud to appear, and the fewest days in the period required for the color to appear on the flower bud, 29,038 days. The largest number of flower stalks is 1,515 stalks per plant, and the largest value in estimating total chlorophyll in leaves is 28,798%.

INTRODUCTION

The scientific name of the jasmine plant is *Hyacinthus orientalis* L. It belongs to the Liliaceae family. The Hyacinthaceae family. The genus *Hyacinthus* is called hyacinth bulbs and is also called *Hyacinthus* bulbs (1). The regions of the Mediterranean basin and Central Asia in Iraq, Syria, Asia Minor, and Greece are considered the original homeland of the plant (2), as well as Western Central Asia (3). When it moved to Europe, the Netherlands became the producer of (95%) of global production. In another statistic for the year 2014, the demand for its cut flowers globally reached 0.5% (4). It is one of the true ornamental bulbs that have been planted since The oldest species name (*orientalis*) means east or sunrise in Arabic (5). 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 growing it in ponds in private and public

gardens (6,7). 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 considered the last barrier before cell separation (8). It was also found that treatment with calcium chloride caused an increase in various vegetative and flowering growth traits (9). Ca^{++} is a universal second messenger and has long been considered the second messenger in many signaling chains, including cell wall defense signals (10). Calcium plays an important role in maintaining the structure of the plant cell and making it strong and cohesive by achieving stability And the stability of the cell membrane. Hence, the role of calcium in improving the quality standards of flowers during the stages of vegetative and flowering growth becomes clear. Calcium works to mitigate the effects of salt stress on the plant, increase the hardness and thickness of the cell wall, strengthen the flower stem, maintain the water balance in the flower, prevent the curvature of the flower neck, and not fully open the flower and reduce rate of senescence and extended vase life (11,8,12).

Gibberellic acid GA3 is known for its effective role in the elongation of stems, petioles, inflorescences, and flower development (13). 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 Liliun, Tulip, Claudius and Freesia (14,15,16). Gibberellins represent a group of plant hormones that stimulate growth. The physiological effects of gibberellins are attributed to their control of enzymatic activity. Its activation of metabolic processes such as increasing carbohydrates, cell division and elongation, and increasing or decreasing fruit set and ripening (17) 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 (18). It also stimulates gibberellin. Seed germination, fruit set, and sex determination, as well as regulate the transition from juvenile to adulthood (19).

In the study conducted by (20) on five varieties of jasmine bulbs (Fondante, Marie, Splendid, Carnegie, Amsterdam), they stated that the five varieties differed significantly from each other in all floral and vegetative traits, with the variety (Fondante) distinguished Plants of the Amsterdam variety need the least number of days to open the first flower compared to other varieties. They attributed the reason to the difference in genetic characteristics, as there are early flowering varieties and late varieties. They also explained that the Fondante variety was significantly distinguished in the shortest time to open the first flower (122). The day and length of the pink inflorescence is 7.433 cm It also showed a significant difference among them in the number of florets per plant, and in the experiment conducted by (22) with the aim of studying the effect of spraying with different concentrations of calcium chloride (0, 500, 1000) mg L⁻¹ on vegetative growth. Flowers and corm yield of two varieties of Gladiolus hybrid. L are the Nova lux variety with yellow flowers and the Trader Lux variety with red flowers. It was found that treatment with calcium chloride at both concentrations of 500 and 1000 mg L⁻¹ led to a significant increase in all the studied traits. In a study conducted by (23), they found that spraying with gibberellic acid had a significant effect on most of the vegetative and floral traits of the Iris Hollandica plant. 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.

METHODOLOGY

The experiment was carried out inside the wooden canopy of the Department of Horticulture and Landscape Design/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), which are (0, 500, 1000). mg L⁻¹ and three levels of gibberellic acid (GA3) (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 plant bulbs *Hyacinthus orientalis* L.

Studied attributes:

The time required for the flower bud to appear (day): Duration required for the flower bud to appear was calculated as the number of days from the date of planting until the flower bud appears between the leaves. (It was calculated for all treated plants).

The time required for the color to appear on the flower bud (day): Calculating the number of days from the appearance of the flower bud between the leaves until pigmentation and the appearance of color on the flowers.

The fresh weight of the flower fennel (gram): The fresh weight of the flower fennel was calculated using a sensitive scale.

Number of flower buds/plant: The number of flower buds per plant was calculated.

Flower stalk length (cm): It was calculated from the top of the flower stalk to the first leaf after all the florets had completely opened on the flower stalk. Determination of total chlorophyll with acetone:

Determination of total chlorophyll with acetone: Chlorophyll in leaves was estimated according to the method (1941.Machinney: 1949.Arnon). The leaves of each plant (the second leaf) were taken from each treatment and placed in special paper bags until they were transported to the laboratory. Then, directly, (200) mg were taken from each leaf and then The wet leaves were crushed using a ceramic mortar with (20) ml of acetone at a concentration of (80%), and the filtrate was separated from the remaining sediment using a Hettich EBA 35 centrifuge, and the absorbance of the filtrate was read at wavelengths 645 - 663.) nanometer using a spectrophotometer Type (/Cam Spectrophoto meter) and the following relationships were used to calculate the amount of chlorophyll type (A, B).

$$\text{Chl.a} = (12.7 (D 663) - 2.69(D 645) \times v) / (1000 \times W).$$

$$\text{Chl.b} = (22.9 (D 645) - 4.68 (D 663) \times v) / (1000 \times W).$$

D = Reading the optical density of extracted chlorophyll at wavelengths (663 and 645) nanometers.

V = The final volume of diluted acetone (80%).

W = wet weight in grams of the extracted plant tissue. This is done using a metric ruler.

RESULTS AND DISCUSSION

Time required for the flower bud to appear (day):

The data in Table (1) showed that there were significant differences in the duration required for the appearance of the flower bud between the plants of the white Carnegie and the pink Fondant varieties of jasmine, where the pink variety recorded the fewest days for the appearance of the flower bud, amounting to 78,935 days, while the white variety recorded a greater number of days, amounting to 82,657 days. It was noted that Also, spraying with calcium chloride at a concentration of 1000 mg L⁻¹ led to a significant delay in the time required for the emergence of the flower bud, which occurred after 79.513 days compared to 82.569 days for the control plants. It was also shown that spraying with gibberellic acid at a concentration of 200 mg L⁻¹ led to Moral earlyness In the period required for the appearance of the flower bud, which occurred after 78,729 days, compared to 83,541 days for the control plants.

It was concluded from the results of the binary interaction between the variety and calcium chloride for the duration required for the appearance of the pink bud to outperform the plants of the pink variety treated with a concentration of 1000 mg L⁻¹ of calcium chloride, as 77,583 days were recorded from planting until the appearance of the bud, compared to 84,305 days For white variety plants not treated with calcium chloride As indicated in the data on the bilateral interaction between the variety and gibberellic acid regarding the duration required for the appearance of the flower bud, we find that spraying the plants with gibberellic acid at a concentration of 200 mg L⁻¹ has led to the plants of the pink variety being superior in the duration from planting until the appearance of the flower bud, as it was recorded as 77,013 days compared to 85,638 days for plants of the white variety not treated with gibberellic acid. Interaction data between calcium chloride and gibberellic acid also indicated that spraying 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 recorded the lowest number of days for bud appearance Syphilis where It reached 77,437 days compared to 86,708 days for plants not treated with calcium chloride combined with spraying with gibberellic acid.

In general, it was found that the results of the three-element interaction showed that the plants of the pink variety Fondant treated with a concentration of 1000 mg L⁻¹ of calcium chloride mixed with spraying with 200 mg L⁻¹ of gibberellic acid were earlier in the period required for the appearance of the flower bud, which occurred after 75,625 days From agriculture While the Carnegie white variety plants not sprayed with calcium chloride and gibberellic acid were delayed by 88,708 days in the time required for the flower bud to appear.

Table 1. The effect of calcium chloride and gibberellic acid and their interactions on the time required for the emergence of the flower bud (day) for 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 | 88.708 a | 82.666 d | 81.541 e | 84.305 a | 82.657 a |
| | 500 | 84.625 b | 81.500 e | 80.541 f | 82.222 b | |
| | 1000 | 83.583 C | 81.500 e | 79.250 g h | 81.444 C | |
| Fondant pink | 0 | 84.708 b | 79.291 g h | 78.500 h i | 80.833 d | 78.935 b |
| | 500 | 80.083 f g | 78.166 I j | 76.916 k | 78.388 e | |
| | 1000 | 79.541 g | 77.583 j k | 75.625 l | 77.583 f | |
| Overlapping of items X Gibberellic acid | the White | 85.638 a | 81.888 b | 80.444 c | impact chloride Calcium | |
| | pink | 81.444 b | 78.347 d | 77.013 e | | |
| Calcium chloride interference X Gibberellic acid | 0 | 86.708 a | 80.979 c | 80.020 d | 82.569 a | |
| | 500 | 82.354 b | 79.833 d | 78.729 e | 80.305 b | |
| | 1000 | 81.562 c | 79.541 d | 77.437 f | 79.513 c | |

| | | | |
|----------------------------|-------------|-------------|----------|
| Effect of gibberellic acid | 83.541 a | 80.118 b | 78.729 c |
|----------------------------|-------------|-------------|----------|

*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.

Time required for color to appear on the flower bud (day):

The results of the statistical analysis in Table (2), regarding the duration required for the color to appear on the flower bud, indicated that there were significant differences between the white Carnegie and the pink Fondant varieties of the jasmine plant, as the pink variety recorded the fewest days for the color to appear on the flower bud, amounting to 29.038 days, while the white variety recorded a number More days, amounting to 31,287 days, and the results of the table indicated that spraying with calcium chloride at a concentration of 1000 mg L⁻¹ It led to a significant delay in the time required for the color to appear on the flower bud of each plant, which occurred after 28,205 days, compared to 32,417 days for the comparison plants. The results also indicated that spraying with gibberellic acid at a concentration of 200 mg L⁻¹ led to a significant delay in the time required for the color to appear on the bud. Flowering occurred after 28,033 days, compared to 32,608 days for the control plants.

The results of the double interaction between the variety and calcium chloride showed the distinction between the plants of the pink variety and those treated with a concentration of 1000 mg L⁻¹ in recording the lowest number of days for the color to appear on the pink bud, which amounted to 27,023 days, compared to 33,442 days for the plants of the comparison treatment of the white variety, as indicated by the intervention data Between the variety and sour Gibberellic acid distinguished the plants of the pink variety treated with a concentration of 200 mg L⁻¹ of gibberellic acid by recording the lowest number of days for the color to appear on the pink bud, which amounted to 26,578 days, compared to 33,230 days for the plants of the white variety not treated with gibberellic acid, and the results of the dual interaction between each showed Intravenous calcium and acid Gibberellic, which is specific to the nature of the time required for the color to appear On the flower bud, spraying 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 recording the lowest number of days for color to appear on the flower bud, which amounted to 25,741 days, compared to 35,247 days for the control plants.

The results of the triple intervention of the studied factors indicated that spraying with a concentration of 1000 mg L⁻¹ of calcium chloride mixed with spraying with 200 mg L⁻¹ of gibberellic acid led to an earlier delay in the time required for the color to appear on the flower bud, which occurred after 24,440 days for the plants of the pink variety Fondant In This is compared to 35,935 days for the Carnegie white variety plants not treated with calcium chloride and gibberellic acid, which were delayed in the period required for color to appear on the flower bud.

Table 2. The effect of calcium chloride, gibberellic acid, and their interactions on the time required for color to appear on the flower bud (day) 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 | 35.935 a | 32.822 c | 31.568 d e | 33.442 a | 31.287 a |
| | 500 | 32.200 cd | 31.045 e f | 29.850 g | 31.031 b | |
| | 1000 | 31.556 d e | 29.850 g h | 27.043 jk | 29.387 c | |

| | | | | | | |
|--|-----------|------------|------------|------------|--------------------------------|----------|
| Fondant pink | 0 | 34.560 b | 31.031 e f | 28.588 h i | 31.393 b | 29.038 b |
| | 500 | 31.433 d e | 27.958 I j | 26.708 k | 28.700 c | |
| | 1000 | 29.963 f g | 26.666 k | 24.440 l | 27.023 d | |
| Overlapping of items X Gibberellic acid | the White | 33.230 a | 31.143 c | 29.487 d | <i>impact chloride Calcium</i> | |
| | Pink | 31.985 b | 28.552 e | 26.578 f | | |
| Calcium chloride interference X Gibberellic acid | 0 | 35.247 a | 31.927 b | 30.078 c d | 32.417 a | |
| | 500 | 31.816 b | 29.501 d | 28.279 e | 29.865 b | |
| | 1000 | 30.760 c | 28.114 e | 25.741 f | 28.205 c | |
| Effect of gibberellic acid | | 32.608 a | 29.847 b | 28.033 c | | |

*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.

Fresh weight of pink fennel (g):

The results of Table 3 indicated that there was a significant effect between the two varieties, where the white variety Carnegie recorded the largest significant values, reaching 42.799 grams, while the pink variety Fondant recorded a weight of 36,211 grams. The data in the table showed that spraying the plants with calcium chloride at a concentration of 1000 mg L⁻¹ He gave The highest values where 43,881 g recorded in opposite 34,644 g for comparison treatment plants, as the data was shown when spraying with the mountains and a concentration of 200 mg⁻¹ to record the top of the values and reached 43,461 g while you were informed of the least of the comparison treatment plants where they gave 35,447 g.

By reviewing the results of the bilateral interference between the class and calcium and found when spraying the plants with a concentration of 1000 mg⁻¹ of calcium chloride, the highest values were registered as it was 46.953 g for white variety plants in opposite 31.101 g for comparison treatment plants, and also the results of the interference between the results The variety and gibberellic acid until spraying the plants of the white variety with a concentration of 200 mg L⁻¹ of gibberellic acid led to recording the largest values, reaching 46.566 grams, compared to 31.746 for the plants of the comparison treatment for the plants of the pink variety. It is noted from the results of the binary interaction between calcium chloride and gibberellic acid that when spraying at a concentration of 1000 mg L⁻¹ of calcium chloride mixed with spraying at a concentration of 200 mg L⁻¹ of gibberellic acid, it resulted in the highest values, reaching 49.176 gm versus 31.496 gm Other plants Treated with calcium chloride and gibberellic acid.

The results of the triple interaction of the factors under study revealed that spraying with a concentration of 1000 mg L⁻¹ of calcium chloride mixed with spraying with 200 mg L⁻¹ of gibberellic acid recorded the highest significant values, reaching 52.440 g for the white Carnegie plants compared to 27.830. Poison for pink plants Fondant not treated with calcium chloride and gibberellic acid.

Table 3. The effect of calcium chloride and gibberellic acid and their interactions on the fresh weight of flower fennel (g) 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 | 35.163 h i | 38.453 f g | 40.943 def | 38.187 c | 42.799 a |
| | 500 | 40.047 e f | 43.410 c d | 46.317 b | 43.258 a | |
| | 1000 | 42.233 d e | 46.187 b | 52.440 a | 46.953 a | |
| Fondant pink | 0 | 27.830 k | 32.397 j | 34.170 h i | 31.101 d | 36.211 b |

| | | | | | | |
|--|-----------|------------|------------|--------------|-------------------------|--|
| | 500 | 32.397 I j | 36.797 g h | 40.983 d e f | 36.726 c | |
| | 1000 | 35.013 h i | 41.497 d e | 45.913 b c | 40.808 b c | |
| Overlapping of items X Gibberellic acid | the White | 39.147 c | 42.683 b | 46.566 a | impact chloride Calcium | |
| | pink | 31.746 e | 36.532 d | 40.355 c | | |
| Calcium chloride interference X Gibberellic acid | 0 | 31.496 g | 34.878 f | 37.556 d e | 34.644 c | |
| | 500 | 36.221 e f | 40.103 c | 43.650 b | 39.992 b | |
| | 1000 | 38.623 c d | 43.841 b | 49.176 a | 43.881 a | |
| Effect of gibberellic acid | | 35.447 C | 39.607 b | 43.461 a | | |

*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 flower spikes (flower spikes⁻¹):

The data in Table (4) indicate that there are significant differences between the two varieties in the number of flower spikes, where the pink variety Fondant recorded the highest values, amounting to 1.515 panicles per plant⁻¹, while the white variety Carnegie recorded the lowest values, amounting to 1.392 panicles per plant⁻¹. From reviewing the table data, it was found Spraying with calcium chloride at a concentration of 1000 mg L⁻¹ gave the highest values, as 1.688 shoots of plant⁻¹ were recorded compared to 1.208 shoots of plant⁻¹ for the comparison treatment plants. The results also indicated that spraying with gibberellic acid at a concentration of 200 mg L⁻¹ led to a significant difference in The number of shoots reached 1,635 shoots per plant⁻¹, while it was lowest for the comparison treatment plants, where it recorded 1,262 shoots per plant⁻¹.

The results of the double interaction between the variety and calcium chloride showed that spraying with a concentration of 1000 mg L⁻¹ of calcium chloride led to recording the highest values, reaching 1.791 plant shoots-1 for the pink variety plants, compared to 1.178 plant shoots⁻¹ for the white variety plants not treated with calcium chloride. The results of the interaction between the variety and gibberellic acid also indicated that when spraying the plants of the pink variety with a concentration of 200 mg l⁻¹ of gibberellic acid, the highest values were recorded, reaching 1.712 shoots of plant⁻¹ compared to 1.221 shoots of plant⁻¹. For the white variety plants not treated with gibberellic acid, the results of the interaction between calcium chloride and gibberellic acid indicate that spraying 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 led to recording the largest values, reaching 1.998 plant shoots⁻¹. In comparison to 1.111 plant shoots⁻¹ for plants not treated with calcium chloride and sprayed with gibberellic acid.

In general, the results of the triple interaction of the factors subject of the study showed that the plants of the pink variety Fondant treated with a concentration of 1000 mg L⁻¹ of calcium chloride combined with spraying with a concentration of 200 mg L⁻¹ of gibberellic acid recorded the highest values, reaching 2.163 shoots per plant⁻¹, while they were the lowest. For Carnegie white cultivar plants not treated with calcium chloride and gibberellic acid, the number reached 1,050 shoots per plant⁻¹.

Table 4. The effect of calcium chloride, gibberellic acid, and their interactions on the number of flower spikes (Shamrack 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 chloride Calcium | Item response |
|----------------|--|--|-----------|-------------|---|---------------|
| | | 0 | 100 | 200 | | |
| Carnegie white | 0 | 1.050 i | 1.206 g h | 1.280 e - h | 1.178 d | 1.392 b |
| | 500 | 1.250 f g h | 1.426 d | 1.560 c | 1.412 c | |
| | 1000 | 1.363 d e f | 1.559 c | 1.833 b | 1.585 b | |

| | | | | | | |
|--|-----------|-----------|-------------|-------------|-------------------------|---------|
| Fondant pink | 0 | 1.173 h | 1.230 f g h | 1.310 d - h | 1.237 d | 1.515 a |
| | 500 | 1.333 d-g | 1.553 c | 1.663 c | 1.516 b | |
| | 1000 | 1.406 d e | 1.803 b | 2.163 a | 1.791 a | |
| Overlapping of items X Gibberellic acid | the White | 1.221 e | 1.397 c | 1.557 b | impact chloride Calcium | |
| | pink | 1.304 d | 1.528 b | 1.712 a | | |
| Calcium chloride interference X Gibberellic acid | 0 | 1.111 f | 1.218 e | 1.295 e | 1.208 c | |
| | 500 | 1.291 e | 1.490 c | 1.611 b | 1.464 b | |
| | 1000 | 1.385 d | 1.681 b | 1.998 a | 1.688 a | |
| Effect of gibberellic acid | | 1.262 c | 1.463 b | 1.635 a | | |

*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.

Flower shamrock length (cm):

It was determined, by studying the results in Table (5) regarding the length of the flower stalk, that there were significant differences between the plants of the two varieties, where the plants of the white variety Carnegie recorded the largest significant values in the length of the flower stalk, which amounted to 20.935 cm compared to 19.583 cm for the plants of the pink variety Fondant, and this appeared in the table data. Spraying with calcium chloride at a concentration of 1000 mg L⁻¹ gave the highest values for the flower stalk length, which was recorded at 21.888 cm compared to 18.326 cm for the plants in the comparison treatment. The data also showed that when spraying plants with gibberellic acid at a concentration of 200 mg L⁻¹, the largest value was recorded, reaching 22.263 cm, while the lowest was recorded for the comparison treatment plants, where it was recorded at 17.631 cm.

The binary interaction data between the variety and calcium chloride indicated that there were significant differences between the white and pink varieties, as it was found that spraying with a concentration of 1000 mg L⁻¹ of calcium chloride led to the highest values in flower shoot length, reaching 22.777 cm for the plants of the white variety, while the lowest was reached for the plants of the S. variety NV The pink that was not treated with calcium chloride recorded 17.486 cm, and it was also clear from the binary interaction data between the variety and gibberellic acid that there were significant differences between the two varieties when sprayed with a concentration of 200 mg L⁻¹ of gibberellic acid, where the largest significant values were recorded and reached 22.888 cm For plants of the white variety, and as below for plants of the pink variety not treated with gibberellic acid, it reached 16.847 cm. It is noted from the interaction data between calcium chloride and gibberellic acid that there are significant differences between the white and pink varieties, as it was found when spraying the plants with a concentration of 1000 mg L⁻¹ of calcium chloride intertwined with Spraying with 200 mg L⁻¹ of gibberellic acid resulted in recording the highest significant values, reaching 23.916 cm compared to 14.166 cm for the control plants.

Finally, it can be said, by looking at the results of the triple interaction of factors, that there is a significant difference between the white varieties Carnegie and the pink Fondant in the flower stalk length. It was found that spraying the plants with a concentration of 1000 mg L⁻¹ overlapping with spraying with a concentration of 200 mg L⁻¹ of gibberellic acid led to The highest values were recorded, reaching 24.791 cm for the plants of the white variety, while the lowest was recorded for the plants of the pink variety, reaching 13.416 cm for the plants of the comparison treatment.

Table 5. The effect of calcium chloride and gibberellic acid and their interactions on the length of the flower stalks (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 | 14.916 h | 20.875 e f | 21.958 c | 19.166 c | 20.935 a |
| | 500 | 19.750 f | 20.916 d e | 21.916 c | 20.861 b | |
| | 1000 | 20.583 e f | 22.958 b | 24.791 a | 22.777 a | |
| Fondant pink | 0 | 13.416 i | 18.791 g | 20.250 e f | 17.486 d | 19.583 b |
| | 500 | 18.291 g | 20.875 d e | 21.625 c d | 20.263 b | |
| | 1000 | 18.833 g | 21.125 c d e | 23.041 b | 21,000 b | |
| Overlapping of items X Gibberellic acid | the White | 18.416 d | 21.500 b | 22.888 a | impact chloride Calcium | |
| | Pink | 16.847 e | 20.263 c | 21.638 b | | |
| Calcium chloride interference X Gibberellic acid | 0 | 14.166 f | 19.708 d | 21.104 c | 18.326 c | |
| | 500 | 19.020 e | 20.895 c | 21.770 b | 20.562 b | |
| | 1000 | 19.708 d | 22.041 b | 23.916 a | 21.888 a | |
| Effect of gibberellic acid | | 17.631 c | 20.881 b | 22.263 a | | |

*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.

Determination of total chlorophyll with acetone:

The laboratory results are shown in Table (6) regarding the determination of chlorophyll in leaves. There were significant differences between the white and pink varieties, as the plants of the pink variety Fondant recorded the highest values, amounting to 28.798 (%), while the white variety Carnegie recorded the lowest values, amounting to 25.736 (%). The table data indicated that spraying the plants with calcium chloride at a concentration of 1000 mg per liter - 1, which resulted in giving the largest values, reaching 29.397 (%) compared to 24.813 (%) for the comparison treatment. Also, spraying plants with gibberellic acid at a concentration of 200 mg L⁻¹ led to obtaining the largest significant values, reaching 32.201 (%) compared to 21.325 (%)) for comparison treatment plants.

In light of the data on the dual interaction between the variety and calcium chloride, it is noted that the highest values of total chlorophyll in the leaves were obtained, which was evident when spraying the plants with calcium chloride, as it reached 31.027 (%) for the plants of the pink variety treated with a concentration of 1000 mg L⁻¹ and decreased to 23. 239 (%) For the white variety plants not treated with calcium chloride, the highest values for chlorophyll estimation were also recorded when the plants were sprayed with gibberellic acid, as it reached 34.475 (%) For plants of the pink variety treated with a concentration of 200 mg L⁻¹, it decreased to 20.291 (%) for plants of the white variety not treated with gibberellic acid. The results of the interaction between calcium chloride and gibberellic acid indicated that spraying with calcium chloride at a concentration of 1000 mg L⁻¹ was mixed with spraying with acid Add gibberellic acid at a concentration of 200 Mg L⁻¹ gave the highest values, reaching 35.893 (%), while this value decreased and reached 21.852 (%) for the comparison plants.

It appeared from the results of the three-way interaction of the study factors that spraying Fondant pink 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, resulted in the highest values reaching 38.483%, while this value decreased. The lowest rate was 16.667 (%) for Carnegie white cultivar plants not treated with calcium chloride and gibberellic acid.

Table 6. The effect of calcium chloride, gibberellic acid, and their interactions on the determination of total chlorophyll with acetone for two varieties of the *Hyacinthus orientalis*.

| 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 | 16.667 h | 25.530 e f | 27.520 d e | 23.239 d | 25.736 b |
| | 500 | 21.773 g | 27.877 d e | 28.957 c d | 26.202 c | |
| | 1000 | 22.433 f g | 27.567 d e | 33.303 b | 27.768 b c | |
| Fondant pink | 0 | 19.713 g | 27.707 d e | 31.747 b c | 26.389 c | 28.798 a |
| | 500 | 21.930 g | 31.813 b c | 33.197 b | 28.980 a b | |
| | 1000 | 25.43 e f | 29.163 c d | 38.483 a | 31.027 a | |
| Overlapping of items X Gibberellic acid | the White | 20.291 e | 26.991 c | 29.926 b | impact chloride Calcium | |
| | pink | 22.358 d | 29.561 b | 34.475 a | | |
| Calcium chloride interference X Gibberellic acid | 0 | 21.852 f | 26.618 d | 29.633 b c | 24.813 c | |
| | 500 | 21.852 e | 29.845 b c | 31.077 b | 27.591 b | |
| | 1000 | 23.933 e | 28.365 c d | 35.893 a | 29.397 a | |
| Effect of gibberellic acid | | 21.325 C | 28.276 b | 32.201 a | | |

*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.

Through the study of plant nutritionists for more than 150 years with the aim of understanding and knowing the plant's needs for chemical nutrients and their accumulation, transport and functions in the plant, the first reference to the nutrients necessary for plant growth was made in 1840 by Liebig, but Srengel is considered the first person to identify calciphylaxis And m on it from One of the major nutrients due to its role in plant growth and differentiation in 1828 (24), Therefore, calcium plays an important central role as a regulator and has a decisive role in plant growth and development, as this divalent cation participates in many life activities (25,26). 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 (8). It was also found that treatment with calcium chloride caused an increase in various vegetative and flowering growth characteristics (9), and Ca⁺⁺ is a universal second messenger and has long been considered the second messenger in many signaling chains, including cell wall defense signals (10). Calcium has an important role in preserving the structure of the plant cell and making it strong and cohesive by achieving stability and stability 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 (11,8,12).

Gibberellins are a group of stimulating plant hormones belonging to the terpene compounds consisting of four Isoprene units containing 19 or 20 carbon atoms arranged in four or five rings containing one or more carboxyl groups. Mevalonic acid is the vital precursor to building gibberellins, and gibberellins are made naturally within... Plant tissue More than 136 species of plant and fungal origin have been isolated (26). Gibberellic acid GA3 is known for its effective role in the elongation of stems, petioles, inflorescences, and flower development (13). Treatment with gibberellic acid plays an important role in enhancing plant development, such as early and induced flowering, and increasing plant height. And the number of leaves, chlorophyll content, yield and quality in various flowering crops such as Liliium, Tulip, Claudius and Freesia (14,15,16). 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 (17). 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 (18). Gibberellin also stimulates seed germination, fruit set, and sex determination, as well as regulates the transition from the juvenile stage to the adult stage (18).

CONCLUSION

This study evaluated the effect of calcium chloride and gibberellic acid on the vegetative growth and flower characteristics of two varieties of *Hyacinthus orientalis* L., namely the variety "Carnegie" with white flowers and "Fondant" with pink flowers. The results showed that the interaction of 1000 mg L⁻¹ calcium chloride and 200 mg L⁻¹ gibberellic acid concentrations resulted in significant increases in various growth parameters, including flower fresh weight, flower stalk length, and number of flower stalks per plant. In addition, the variety "Fondant" showed advantages in the parameters of shorter time to flower bud emergence and bud coloration compared to the variety "Carnegie". These data highlight the potential of the combination of calcium chloride and gibberellic acid in optimizing flower quality and productivity in ornamental plants, while also confirming the significant influence of genetic varieties on plant responses to treatments. This study provides a foundation for further applications in ornamental plant cultivation, especially in conditions that require improved flower aesthetic quality.

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