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Effect of Calcium Chloride and Gibberellic Acid on Flowering Growth of Two Cultivars of *Gladiolus X hortulanus* L.

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Abstract. This study was conducted inside the wooden canopy of the Department of Horticulture and Landscape Engineering / College of Agriculture and Forestry / University of Mosul during the agricultural season (2022-2023). 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 flowering growth of two varieties of Gladiolus *hortulanus* .They are Nova lux with yellow flowers and Trader Lux with red flowers . The corms were planted on 17/3/2022, then sprayed 30 days after planting the corms with three sprays and three concentrations of calcium chloride (0,500, 1000) mg.L^{-1} The plants were also sprayed with gibberellic acid, with three sprays and three concentrations (0, 100, 200), The period between one spray and another was two weeks. The spraying was done with gibberellic acid after 35 days of planting the corms. The study was carried out using a factorial experiment in the design of completed randomized sectors R.C.B.D within split plots with three replications, each experimental unit included (7) corms for each replicate. The yellow cultivar recorded the shortest period for color to appear in the first inflorescence, which amounted to 79.092 days, and the largest values in the fresh weight of the flower and the inflorescence, which amounted to 50.663 g. The diameter of the first flower reached 78.794 mm, the largest length of the inflorescence reached 41.285 cm, and the largest diameter of the flower stalk reached 9.294 mm. Also, there were no significant differences between the two cultivars in the characteristic of the number of florets per plant .The treatment with calcium chloride at both concentrations of 500 and 1000 mg.L^{-1} resulted in a significant increase in all studied traits. The treatment resulted in gibberellic acid at a concentration of 200 mg. L^{-1} resulted in a significant increase in all studied traits.

Keywords. Gibberellic Acid, Flowering Growth, Gladiolus X hortulanus L.

1. Introduction

Gladiolus X hortulanus L belongs to the Iridaceae family. It is the largest genus in this large and diverse family, which includes about 92 genera, and consists of 260 species It is a monocotyledonous plant characterized by the growth of one terminal bud. It is native to southern and central Africa, Asia Minor, and southern Europe. Its name goes back to the Latin word (Gladius), which means little sword, concerning the sword-shaped shape of the leaves. As for the name of the species, hortulanus, Calcium chloride is one of the essential compounds in regulating growth and development in plants, in

addition to its involvement in forming the cell wall. It also affects the integrity of the cell wall and is the last barrier before cell separation [1]. It was also found that the treatment with calcium chloride caused an increase in the different vegetative and flowering growth characteristics [2]. Ca++ is considered a universal second messenger and has long been considered the second messenger in many signaling cascades, including cell wall defense signals [3]. Calcium has an important role in preserving the structure of the plant cell and making it strong and cohesive by achieving The cell membrane stability. Hence, the role of calcium is evident in improving the quality standards of flowers during the vegetative and flowering growth stages. Calcium works to reduce the effects of salt stress on the plant, increase the hardness and thickness of the cell wall and strengthen the stem. Syphilis, maintaining the water balance in flowers, preventing the bending of the flower neck, incomplete blooming of the flower, reducing the aging rate and prolonging the flowering life [1,4,5]. Gibberellic acid GA_3 is known for its role in the elongation of axial organs (stems, petioles and inflorescences) and the development of flowers in Lilium plants [6] Treatment with gibberellic acid plays an essential role in enhancing various processes during plant development, early and induced flowering, increasing plant height, number of leaves, chlorophyll content, yield and quality across multiple flowering crops such as allium, tulip, gladioli and freesia [7-9].

2. Materials and Methods

The purpose of this study was to examine the impact of spraying with calcium chloride, gibberellic acid, and the interaction between the two on the flowering growth of two varieties of Gladiolus x hortulanus. The experiment was conducted in the greenhouse of the Department of Horticulture and Landscape Engineering in the College of Agriculture and Forestry at the University of Mosul from March to October of 2022. L. Three variables were analyzed in this experiment.

2.1. The Varieties

Trader horn with red flowers and Nova lux with yellow flowers.

2.2. Calcium Chloride

Calcium chloride was sprayed on the shoots at three levels (0, 500 and 1000 mg). L^{-1}, by three sprays on the vegetative shoot, the first spraying was after a month of germination, and the period between one spraying and another was two weeks.

2.3. Gibberellic Acid (GA3)

Gibberellic acid, GA_3, was added to the plant in three concentrations (0, 100, and 200 mg). L^{-1} by dissolving it with distilled water and then spraying it on the plant three times. The first spray was after (35) days of germination, and the period between one spray and another is two weeks.

2.4. Studied Traits

- Time required for the color to appear in the first flower (day).
- Number of florets. $Plant^{-1}$.
- Inflorescence length (cm).
- Diameter of flower stand (mm).
- The duration of the florets remaining on the plant (one day).
- The blooming age (day).

3. Results and Discussion

3.1. The Time Required for the Color to Appear in the First Flower (day)

The data of Table (1) indicated that there were significant differences in the characteristic of the duration required for the appearance of color in the first flowering between plants of the yellow and red varieties of Gladiolus, where the yellow variety recorded the least days for the appearance of color in the first flowering and reached 79.092 days, while the red variety recorded more days and amounted to 82.064 days, and it was found that spraying with calcium chloride at a concentration of 1000 mg. L^{-}

^{1} led to a significant earlier in the period required for the appearance of color in the first flower, which occurred after 78.881 days compared to 82.491 days for control plants. It was also found that spraying with gibberellic acid at a concentration of 200 mg. L^{-1} led to a significant earlier in the period required for the appearance of color in the first flower, which occurred after 79.466 days compared to 82.251 days for control plants.

The results of the bilateral interaction between the cultivar and calcium chloride for the duration required for the color to appear in the first flower showed that the plants of the yellow cultivar treated with a concentration of 1000 mg had superiority. L^{-1} of calcium chloride, as it recorded 77.419 days from cultivation until the appearance of color in the first flower, compared to 83.929 days for the red variety plants not treated with calcium chloride. Also, the results of the bilateral interaction between the cultivar and gibberellic acid for the duration required for the color to appear in the first flower indicated that spraying the plants with gibberellic acid at a concentration of 200 mg. L^{-1} led to the superiority of the yellow cultivar plants in the period from sowing until the appearance of color in the first flower, as it recorded 77.971 days compared to 83.778 days for the red cultivar plants not treated with gibberellic acid. While 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} mixed with spraying with gibberellic acid at a concentration of 200 mg. L^{-1} recorded the lowest number of days for color to appear in the first flower, which reached 76.892 days, compared to 83.657 days for plants not treated with calcium chloride overlapping with spraying with gibberellic acid. According to the findings of the triple interaction of the elements, plants of the yellow cultivar given a dose of 1000 mg benefited the most. Calcium chloride spray at 200 milligrams per liter (mg L^{-1}).

There was a significant difference in the time required for the appearance of color in the first inflorescence between plants of the red variety that were sprayed with calcium chloride and gibberellic acid and those that were not; the plants sprayed with gibberellic acid and calcium chloride bloomed 75.403 days after planting. the answer is yes Early flowering can be explained by the availability of a large amount of carbohydrates during the phase of vegetative growth, which can be inferred from the correlation between the number of leaves and the percentage of chlorophyll in the leaves at the time of flower harvest. Treatment with 200 milligrams per kilogram of gibberellic acid was effective, according to the findings. L^{-1} helped reduce the time between when the first blossom opened and when it showed color. Increases in photosynthesis and carbon dioxide fixation during the early stages of growth may account for the beneficial effects of gibberellic acid on this quality [10].

Table 1. The effect of spraying with calcium chloride and gibberellic acid and their interactions on the time required for color to appear in the first flower (day) for two varieties of Gladiolus hortulanus L.

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova lux	0	81.95 b cd	80.837 d e	80.373 e	b79.092	82.491 a	81.053 c
	500	80.293 e	77.98 f	78.137 f		80.36 b	78.803 d
	1000	79.927 e	76.927 f	75.403 g		78.88 c	77.419 e
Trader lux	0	85.363 a	83.243 b	83.18 b	a82.064		83.929 a
	500	83.283 b	81.153 d e	81.323 cd e			81.92 b
	1000	82.687 b c	79.963 e	78.38 f			80.343 c
Gibberellin Average		a 82.251	80.017 b	79.466 b			
Class Overlap X Gibberellin							
Nova Lux		80.723 b	78.581 c	77.971 c			
Trader Lux		83.778	81.453	80.961			

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
		a	b	b			
Calcium X Gibberellin Interference							
	0	83.657 a	82.04 b	81.777 b			
	500	81.788 b	79.567 c	79.73 c			
	1000	81.307 b	78.445 d	76.892 e			

*Averages that share the same letter for each factor and each interaction do not differ significantly between them according to Duncan's polynomial test at the probability level (P<0.05).

3.2. The Number of Florets.Plant $^{-1}$

There were no statistically significant differences between the yellow and red gladiolus cultivars in terms of the quantity of florets per plant, as shown in Table (2). According to the data in the table, spraying a solution containing 1000 mg of calcium chloride was the most effective method. L^{-1} caused a dramatic increase in early-age floret production, with a maximum of 15,542 florets per plant. plant^{-1} versus the average of 13.764 for control plants. Spraying with 200 mg/L of gibberellic acid showed positive outcomes, too. The maximum number of florets, 15.4, was recorded after treating with L^{-1}. One plant yielded 13.862 blossoms. Plant^{-1} in the control group, Plants of the red cultivar that were given a calcium chloride concentration of 1000 milligrams stood out from the rest, indicating a binary interaction between the cultivar and the chemical.

In terms of total florets generated, L^{-1} topped the charts with 15,796. One plant yielded 13,028 flowers. In the case of the yellow cultivar used as a control group, Plant^{-1}. The interaction data between the cultivar and gibberellic acid indicated that the plants of the red variety treated with a concentration of 100 mg.l^{-1} of gibberellic acid produced the largest number of flowers, which reached 15,667 flowers. Plant^{-1} compared to 13.206 flowers. Plant^{-1} for yellow cultivar plants not working with gibberellic acid. The data of the dual interaction between calcium chloride and gibberellic acid, which is related to the number of flowers. Plant^{-1}, indicated that spraying with calcium chloride at a concentration of 1000 mg.L^{-1} overlapped with spraying with gibberellic acid at a concentration of 200 mg. L^{-1} recorded the highest values, reaching 16.417 florets. plant^{-1} compared to 11.925 florets. plant^{-1} for the control plants. The results of the triple interaction of the factors also indicated that spraying at a concentration of 1000 mg. L^{-1} of calcium chloride mixed with 200 mg spray. L^{-1} of gibberellic acid gave the highest values of 16.517 florets. Plant^{-1} for yellow cultivar plants compared to 10.333 flowers. Plant^{-1} for plants of the same variety that were not treated with calcium chloride and gibberellic acid. It was observed from the data of Table (2) a significant increase in the number of florets when treated with calcium chloride at a concentration of 1000 mg. L^{-1} .

The results may be explained according to what was mentioned above about the increase in the number of leaves and the intensity of chlorophyll, which was reflected in the abundance of nutrients available for the growth of inflorescences and florets, or the ability of calcium to maintain the structure of cells intact by preserving the integrity of the cell membrane and regulating the selective ionic transport of essential nutrients [11] .The significant effect of gibberellin in increasing the number of florets on the vine could be attributed to the effectiveness of gibberellin at its optimum levels in stimulating the lateral buds to vigorously growth and flowering [12]. It caused the length of the stems and the length of the inflorescence, and thus was reflected in the number of florets.

Table 2. Effect of spraying with calcium chloride and gibberellic acid and their interactions on the number of flowers / plant of two varieties of *Gladiolus hortulanus* L.

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova lux	0	10.333 e	13.5 d	15.25 a–d	14.278 a	13.764 b	13.028 c
	500	14.083 cd	14.967 a–d	14.5 b cd		14.897 a	14.517 b
	1000	15.2 a–d	14.15 cd	16.517 a		15.542 a	15.289 a b
Trader lux	0	13.517 d	15 a – d	14.983 a–d	15.191 a		14.5 b
	500	14.667 a–d	16.333 a b	14.833 a–d			15.278 ab
	1000	15.403 a–d	15.667 a b c	16.317 a b			15.796 a
Gibberellin Average		b13.867	14.936 a	15.4 a			
Class Overlap X Gibberellin							
Nova Lux		13.206 d	14.206 c	15.422 a b			
Trader Lux		14.529 b c	15.667 a	15.378 a b			
Calcium X Gibberellin Interference							
0		11.925 d	14.25 c	15.117 b c			
500		14.375 b c	15.65 a b	14.667 b c			
1000		15.302 a b c	14.908 b c	16.417 a			

* Duncan's polynomial test at the 0.05 level indicates that averages with the same letter for each factor and each interaction do not differ substantially from one another.

3.3. Inflorescence Length(cm)

By studying the data in Table (3) related to the length of the inflorescence, it became clear that there were significant differences between the plants of the two cultivars. Calcium at a concentration of 1000 mg. L^{-1} gave the highest values as it recorded 40.196 cm compared to 36.322 cm for control plants. The data also showed when spraying the plants with gibberellic acid at a concentration of 200 mg. L^{-1} recorded the highest values, which amounted to 41.133 cm, while the lowest values were recorded for the plants of the control treatment, where it recorded 35.434 cm. The interaction data between the cultivar and calcium chloride indicated that there was a significant difference between the two cultivars, as it was found when spraying the plants with a concentration of 1000 mg. L^{-1} of calcium chloride gave the highest values and reached 43.082 cm for the red cultivar plants, while it reached the lowest for the yellow cultivar plants not treated with calcium chloride and recorded 33.294 cm. It was clear from the interaction data between the cultivar and gibberellic acid that there was a significant difference between the two cultivars when spraying the plants with a concentration of 200 mg.L-1 of gibberellic acid, where the highest significant values were recorded and reached 43.79 cm for the red cultivar plants, and it reached the lowest for the yellow cultivar plants not treated with gibberellic acid and amounted to 32.284 cm, It was clear from the data of the binary interaction between calcium chloride and gibberellic acid that there is a significant difference between the two varieties, as it was found when spraying plants with a concentration of 1000 mg. L^{-1} of calcium chloride mixed with spraying with 200 mg. L^{-1} of gibberellic acid gave the highest significant values, which amounted to 43.93 cm, compared to 34.284 cm for control plants not treated with calcium

chloride mixed with gibberellic acid. It can be said through the statistical analysis of the results of the triple interaction of the factors that there are significant differences between the two cultivars in the characteristic of inflorescence length, as it was found that spraying the plants with a concentration of 1000 mg. L^{-1} mixed with spraying at a concentration of 200 mg. L^{-1} of gibberellic acid led to the recording of the highest values, reaching 46.763 cm for plants of the red variety, while it reached the lowest for plants of the yellow variety, reaching 31.146 cm for plants not treated with calcium chloride and gibberellic acid. The results may be interpreted according to the role of calcium in maintaining the structure and function of the cell wall, and that it is one of the most important components for giving strength, toughness, toughness and resistance to cell walls, as the mechanical resistance of stems and flower stalks is closely related to the content of cell walls of calcium associated with pectin in the form of intertwined chains and aggregated to form a solid wall [13,14] . The results also showed in the table that the treatment with gibberellic acid at a concentration of 200 mg. L^{-1} may be the cause of the increase in inflorescence length, through the direct effect of gibberellin in regulating growth, the presence of GA3 may increase growth-encouraging enzymes related to the synthesis of more nucleic acids and others in the plant.

Table 3. Effect of spraying with calcium chloride and gibberellic acid and their interactions on inflorescence length of two varieties of *Gladiolus hortulanus* L.

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova lux	0	31.146 k	34.003 i j	34.733 i	35.640 b	36.322 b	33.294 e
	500	32.606 j	36.740 h	39.600 e f		38.869 a	36.316 d
	1000	33.100 j	37.736 g h	41.096 d e		40.196 a	37.311 cd
Trader lux	0	37.423 g h	39.906 e f	40.723 d e	41.285 a		39.351 b c
	500	38.790 f g	41.596 cd	43.883 b			41.423 a b
	1000	39.540 e f	42.943 b c	46.763 a			43.082 a
Gibberellin Average		35.434 c	38.821 b	41.133 a			
Class Overlap X Gibberellin							
Nova Lux		32.284 e	36.160 d	38.476 c			
Trader Lux		38.584 c	41.482 b	43.790 a			
Calcium X Gibberellin Interference							
0		34.285 h	36.955 e f	37.728 e			
500		35.698 g	39.168 d	41.741 b			
1000		36.320 f g	40.340 c	43.930 a			

*Averages that share the same letter for each factor and each interaction do not differ significantly between them according to Duncan's polynomial test at the probability level (P<0.05)

3.4. Diameter of Flower Stand (mm)

The results of the statistical analysis in Table (4) showed that there was a significant difference in the diameter of the flower stalk, where the red cultivar recorded the highest significant values, amounting to 9.294 mm, compared to 8.335 mm for the yellow cultivar. It was also clear from the results of the

table that the plants were sprayed with a concentration of 1000 mg.L^{-1} of calcium chloride recorded the highest values, reaching 9.282 mm against 8.359 mm for the control plants. The results of the table also indicated that spraying plants with a concentration of 200 mg. L^{-1} of gibberellic acid recorded the highest values, reaching 9.656 mm compared to 7.871 mm for plants of the comparison treatment, and it was found from the data of the binary interaction between the cultivar and calcium chloride that there was a significant difference between the two cultivars, as it was found when spraying the plants with a concentration of 1000 mg. L^{-1} of calcium chloride gave the highest values and reached 9.837 mm for the red cultivar plants, while it reached the lowest for the yellow cultivar plants not treated with calcium chloride and recorded 7.95 mm. The data of the binary interaction between the cultivar and gibberellic acid indicated that there was a significant difference between the two cultivars when spraying the plants with a concentration of 200 mg. L^{-1} of gibberellic acid, where the highest significant values were recorded and reached 10.238 mm for the red cultivar plants, and it reached the lowest for the yellow cultivar plants not treated with gibberellic acid and amounted to 7.474 mm. The results indicated that the interaction between calcium chloride and gibberellic acid was found when spraying at a concentration of 1000 mg. L^{-1} with calcium chloride overlapped with spraying at a concentration of 200 mg. L^{-1} with gibberellic acid led to recording the highest significant values, which amounted to 10.455 mm, compared to 7.565 mm for plants not treated with calcium chloride and gibberellic acid. Finally, it was found from the results of the triple interaction of the elements that there was a significant difference between the two cultivars in the characteristic of flowering diameter, where it was found that spraying plants with a concentration of 1000 mg.L^{-1} interfered with spraying with a concentration of 200 mg. L^{-1} of gibberellic acid led to the recording of the highest significant values, reaching 11.153 mm for the red cultivar plants, compared to 7.266 mm for the yellow cultivar plants not treated with calcium chloride and gibberellic acid [10].

Table 4. Effect of spraying with calcium chloride and gibberellic acid and their interactions on flowering diameter of two varieties of *Gladiolus hortulanus* L.

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova lux	0	7.266 k	8.170 h i	8.413 g h	8.335 b	8.359 c	7.950 e
	500	7.466 j k	8.470 g h	9.053 d e f		8.802 b	8.330 d
	1000	7.690 i j k	8.733 e f g	9.756 b c		9.282 a	8.726 c
Trader lux	0	7.863 i j	9.080 d e f	9.363 cd	9.294 a		8.768 c
	500	8.396 g h	9.230 d e	10.200 b			9.275 b
	1000	8.546 f g h	9.813 b c	11.153 a			9.837 a
Gibberellin Average		7.871 c	8.916 b	9.656 a			
Class Overlap X Gibberellin							
Nova Lux		7.474 e	8.457 d	9.074 c			
Trader Lux		8.268d	9.374 b	10.238 a			
Calcium X Gibberellin Interference							
0		7.565 e	8.625 c	8.888 c			
500		7.931 d	8.8500 c	9.626 b			
1000		8.118 d	9.273 b	10.455 a			

*Averages that share the same letter for each factor and each interaction do not differ significantly between them according to Duncan's polynomial test at the probability level (P<0.05)

3.5. The Duration of the Florets Remaining on the Plant (day)

The results of the statistical analysis in Table (5) indicated that there was a significant difference in the duration of the florets remaining on the plant, where the yellow variety recorded the highest significant values and reached 21.474 days compared to 19.838 days for the red variety plants. The results of the table indicated that spraying the plants with a concentration of 1000 mg.L^{-1} of calcium chloride recorded the highest values, reaching 9.282 days, compared to 8.359 days for control plants. It was also found from the results of the table that spraying plants with a concentration of 200 mg. L^{-1} of gibberellic acid recorded the highest values, reaching 9.656 days, compared to 7.871 days for the plants of the control treatment. The data of the binary interaction between the cultivar and calcium chloride indicated that there was a significant difference between the two cultivars, as it was found when spraying the plants with a concentration of 1000 mg. L^{-1} of calcium chloride gave the highest values and reached 22.867 days for the yellow variety plants, while it reached the lowest for the red variety plants not treated with calcium chloride and recorded 18.886 days. It was also clear from the data of the bilateral interaction between the cultivar and gibberellic acid that there is a significant difference between the two cultivars when spraying the plants with a concentration of 200 mg. L^{-1} of gibberellic acid, where the highest significant values were recorded and reached 24.104 days for the yellow cultivar plants, as it reached the lowest for plants of the same variety not treated with gibberellic acid and reached 17.466 days. On the other hand, the results of the dual interaction between calcium chloride and gibberellic acid when spraying at a concentration of 1000 mg.L^{-1} with calcium chloride overlapping with spraying at a concentration of 200 mg.L^{-1} with gibberellic acid indicated that the highest significant values were recorded, which amounted to 24.168 days compared to 16.440 days for untreated plants. calcium chloride and gibberellic acid, In sum, and from the results of the triple interaction of the factors, it can be indicated that there is a significant difference between the two cultivars in the characteristic of the duration of the florets remaining on the plant, as it was found that spraying the plants with a concentration of 1000 mg.L^{-1} interfered with spraying with a concentration of 200 mg. L^{-1} of gibberellic acid led to recording the highest significant values of 25.740 for the yellow cultivar plants, compared to 15.650 days for the yellow cultivar plants not treated with calcium chloride and gibberellic acid. It was observed from the data of Table (7) a significant increase in the duration of the florets remaining on the plant when treated with calcium chloride at a concentration of 1000 mg L^{-1}. The results may be explained according to what was previously mentioned about the increase in the number of leaves and the intensity of chlorophyll, which was reflected in the abundance of nutrients available for the growth of inflorescences and florets or the ability of Calcium is involved in maintaining an intact cell structure by maintaining the integrity of the cellular membrane and regulating the selective ionic transport of essential nutrients [11].

Table 5. Effect of spraying with calcium chloride and gibberellic acid and their interactions on the duration of flowering on the plant for two varieties of *Gladiolus hortulanus* L.

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova lux	0	15.650 n	21.413 e f g	22.110 d e f	21.474 a	19.305 c	19.724 cd
	500	17.706 l m	23.320 b cd	24.463 b		20.891 b	21.830 b
	1000	19.043 j k l	23.820 b c	25.740 a		21.772 a	22.867 a
Trader lux	0	17.230m	19.523 i j k	19.906 h i j	19.838 b		18.886 d
	500	17.696 l m	20.620 h i j	21.540 e f g			19.952 c
	1000	18.330 k l m	21.103 f g h	22.596 cd e			20.676 c
Gibberellin Average		17.609c	21.633 b	22.726 a			
Class Overlap X Gibberellin							

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova Lux		17.466 e	22.851 b	24.104 a			
Trader Lux		17.752 e	20.415 d	21.347 c			
Calcium X Gibberellin Interference							
	0	16.440 g	20.468 d	21.008 d			
	500	17.701 f	21.970 c	23.001 b			
	1000	18.686 e	22.461 b c	24.168 a			

*Averages that share the same letter for each factor and each interaction do not differ significantly between them according to Duncan's polynomial test at the probability level (P<0.05).

3.6. The Flowering Age (day)

It is noted from the results of the statistical analysis in Table (6) that there is a significant difference in the flowering age, where the yellow cultivar recorded the highest significant values and reached 10.888 days compared to 9.648 days for the red cultivar plants. It was also noted from the results of the table that spraying the plants with a concentration of 1000 mg.L^{-1} Of calcium chloride, the highest values were recorded, reaching 12.083 days, compared to 7.916 days for control plants. The results of the table also indicated that spraying the plants with a concentration of 200 mg. L^{-1} of gibberellic acid recorded the highest values, reaching 11.666 days compared to 8.694 days for the control plants, and the data of the binary interaction between the cultivar and calcium chloride showed that there was a significant difference between the two cultivars, as it was found when spraying the plants with a concentration of 1000 mg. L^{-1} of calcium chloride gave the highest values and reached 12.833 days for the yellow cultivar plants, while it reached the lowest values for the plants of the same variety not treated with calcium chloride and recorded 8.000 days. The data of the bilateral interaction between the cultivar and gibberellic acid indicated that there was a significant difference between the two cultivars when spraying the plants with a concentration of 200 mg.L^{-1} of gibberellic acid, where the highest significant values were recorded and reached 12.166 days for the yellow cultivar plants, and the lowest for the red cultivar plants not treated with gibberellic acid. It reached 8,555 days. The results also indicated the bilateral interaction between calcium chloride and gibberellic acid, as it was found when spraying at a concentration of 1000 mg.L^{-1} with calcium chloride overlapping with spraying at a concentration of 200 mg.L^{-1} with gibberellic acid, which led to recording the highest significant values, which amounted to 14,000 days, compared to 5,833 days for non-plants. Treatment with calcium chloride and gibberellic acid, In sum, from the results of the triple interaction of the factors, it can be indicated that there is a significant difference between the two cultivars in the characteristic of the flowering age, as 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 recording the highest significant values, which reached 15,000 days for the yellow variety plants compared to 5,000 days for the red variety plants not treated with calcium chloride and gibberellic acid.

Table 6. Effect of spraying with calcium chloride and gibberellic acid and their interactions on the flowering life of two varieties of *Gladiolus hortulanus* L.

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
Nova lux	0	6.666 j k	8.166 i j	9.166 h i j	10.888 a	7.916 b	8.000 c
	500	11.500 b –e	11.666 b cd	12.333 b cd		10.805 a	11.833 a b
	1000	10.666 d –h	12.833 b c	15.000a		12.083 a	12.833 a
Trader lux	0	5.000 k	9.000h i	9.500 f–i	9.648 b		8.611 c

Varieties	Calcium	Gibberellins			Class Average	Average Calcium	Class × Calcium Overlap
		0	100	200			
	500	8.666 i	9.666 e-i	11.000 c -g			9.777 b c
	1000	9.666 e -i	11.333 b –f	13.000 b			11.333 a b
Gibberellin Average		8.694 c	10.444 b	11.666 a			
Class Overlap X Gibberellin							
Nova Lux		9.611 d	10.888 b c	12.166 a			
Trader Lux		8.555 e	10.000 cd	11.166 a b			
Calcium X Gibberellin Interference							
0		5.833 g	8.583 f	9.333 e f			
500		10.083 d e	10.666 cd	11.666 b c			
1000		10.166 d e	12.083 b	14.000 a			

*Averages that share the same letter for each factor and each interaction do not differ significantly between them according to Duncan's polynomial test at the probability level (P<0.05).

Conclusions and Recommendations

In light of the obtained results, we conclude the following:

- Through the study, it was possible to produce cut flowers of two varieties of Gladiolus X hortulanus L. with good quality and at an inappropriate date for production due to high temperatures, high light intensity and low relative humidity.
- The cultivar "Nova Lux" with yellow florets recorded the shortest duration for the appearance of color in the first floret, the largest values in the fresh weight of the flower and the flower stalk, the longest duration for the survival of florets on the plant and the longest inflorescence of flowers, and the second variety Trader Lux "" with red florets recorded the largest diameter of the flower The first, the longest inflorescence length, and the largest diameter of the flower stand, and there were no significant differences between the two cultivars in the number of florets on the plant.
- It was treated with calcium chloride at a concentration of 1000 mg. L^{-1} showed a positive effect on all traits under study compared to no supplementation.
- It was treated with gibberellic acid at a concentration of 200 mg. L^{-1} indicated a positive effect on all traits under study compared to no supplementation.
- The joint cooperative effect of the study factors contributed positively to improving all the characteristics under study.

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