

EFFECT OF FOLIAR APPLICATION OF CALCIUM CHLORIDE AND SALICYLIC ACID ON GROWTH AND FLOWERING OF THREE *Gladiolus X hortulanus* L. CULTIVARS.

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ABSTRACT

This experiment was carried out in the Green net house at the College of Agriculture and Forestry for the period from April to September 2019, with the aim of assessing the response of three cultivars of *Gladiolus X hortulanus* L. for treatment with (SA) at a concentrations of zero and 250 mg.l⁻¹ as well as treatment with (CaCl₂) concentrations are zero, 500 and 1000 mg.l⁻¹ sprayed on the vegetative growth twice. The results indicated the following: The red cultivar recorded the largest height, the number of leaves, shortest the period from planting to the inflorescence bud initiation and longest vase life, While the white cultivar recorded the largest value of spike length. The plants sprayed with SA had a significant effect in recording the largest values of all studied traits except for the duration from planting to the inflorescence bud initiation, which decreased significantly. The treatment with CaCl₂ with both concentrations resulted in a significant increase in the number of leaves and the spike length, The treatment with CaCl₂ at 1000 mg.l⁻¹ gave the largest values for the plant height and the vase life. showed that red and white cultivars produced flower that fall within a special grade when they were sprayed with SA or did not interact with spraying with CaCl₂ at 1000 mg.l⁻¹, while the violet cultivar ended their flowering 5 days when they were sprayed with SA interact with CaCl₂ at 1000 mg.l⁻¹.

Keywords: *Gladiolus*, Calcium Chloride (CaCl₂), Salicylic acid (SA), Cultivars.

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INTRODUCTION

Gladiolus X hortulanus L. is followed by the Iridaceae family and Ixioideae (Crocoideae) subfamily. The genus of *gladiolus* is the largest genera of this family which consist of 270 species and 1000 cultivars, spread naturally in the regions of South Africa, the Mediterranean and Central Europe, (Quattrocchi, 2012). It is a perennial herbaceous plant that reproduces with seeds or tissue culture technique, in addition to its propagation with corms and cormels. The leaves are sword-shaped, light green in color with several prominent veins, the inflorescences are called a spike, which consistent of the numerous florets, each one a tubular corolla with several petals of one or more colors and fluted or smooth edges (Chopra and Singh, 2013).

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Hanks (2018) stated that the Netherlands controls the export of fresh cut gladiolus flowers to the United States of America, which has a marketing value of 29.2 million euros, and the cultivated area under the control environment conditions in the Netherlands constitutes 31% of the total area of other international cut flowers. The cultivated area in Germany with gladiolus is estimated at 1000 hectares, and flower production in India reached 55 million flowers for the year 2014.

Gladiolus is very rich in its cultivars, and every year new varieties are added, so the evaluation of the produced varieties has become important to knowing their suitability to environmental conditions and market requirements (Kumar *et al.*, 2019).

Mushtaq *et al.* (2013) indicated that the response of varieties is influenced by the different cultivation environment and genotype. In their study to evaluate the performance of four varieties of *Gladiolus alatus* are: Florared, Fado, Madriver and Pietmohlen, they noted that there are significant differences between the varieties in the recorded values of most characteristics of vegetative and floral growth. The cultivar Pietmohlen distinction in most traits including: leaf length, leaf area, duration to flowering, number and size of floret per plant. The cultivar Florared gave the largest value of leaves 7.50 leaf.plant⁻¹ and vase life 5.08 days.

Plant growth regulators are the third factor affecting the improvement of plant growth and development after genetic and environmental factors (Pahade, 2015). Anwar *et al.* (2014) in his experiment on the tuberose plant, sprayed with salicylic acid on the vegetative growth three times, the first after 40 days of planting, the second and third sprayed on weekly intervals at concentrations: 0.0, 0.1, 0.5 and 1.0 mmol.l⁻¹. The data showed that plants treated with 1.0 mmol.l⁻¹ gave a significant increase in most the traits studied include: plant height 91.30 cm, number of leaves per plant 25.00 leaf.plant⁻¹, and vase life 14.5 days compared with control.

Calcium plays an important role as a regulator of plant growth and development, as this divalent cation participates in many life events (Hirschi, 2004). Sharma *et al.* (2013) suggest that spraying the vegetative growth of *Gladiolus* cv. Aldebran with calcium sulfate at a concentration of 0.75% was effective in improving most traits, especially the size of the inflorescence, the floret, and the length of the floret reached 8.08 cm compared to 7.92 cm for control, as well as the vase life reached 17.61 days compared to 14.79 days for control.

The aim of the study: To demonstrate the response of three varieties of *Gladiolus* to treatment with salicylic acid and calcium chloride and their effect on the characteristics of vegetative and floral growth under the environmental conditions of Mosul in the summer.

MATERIALS AND METHODS

The experiment was carried out in the canopy of the green net of the Department of Horticulture and Landscape Design/ College of Agriculture and Forestry/ Mosul University, during the period from April 2019 to September 2019, used three varieties of *Gladiolus X hortulanus* L. are: "Break of dawn" with white flowers and "Espresso" with red flowers and "blue frost" with violet flowers.

Salicylic acid was used in two concentrations: 0 and 250 mg.l⁻¹ and calcium chloride in three concentrations: 0, 500 and 1000 mg.l⁻¹ were sprayed on the vegetative growth twice: first after being three leaves and the second after formed the sixth leaf on the plant. It was used the Factorial Experiment in the Complete Randomized Block Design with three replicates and 15 plants per treatment.

The corms were planted in the canopy of the green net in rows, the distance between one row and another 30 cm, by five corms in row.

Inflorescences were classified to four degrees to the rachis length according to the degrees of the American Society of Gladiolus (Fairchild, 1979).

The vase life (day), the inflorescences were harvested in the early morning in a stage that opens 1-2 basal flowers on the inflorescence (Reid and Jiang, 2012). The length of the inflorescence was standardized 50 ± 2 cm, then placed in 500 ml plastic bottle containing distilled water which is a preservative solution, the inflorescences were ended the vase life when fading of the sixth basal floret (Han, 2003).

The urea nitrogen fertilizer used CO (NH₂) 46% N (Iraqi origin) by 42 kg per du., potassium fertilizer in the form of potassium sulfate 42% K₂O (Jordanian origin) by 68 kg per du. and the phosphate fertilizer in the form of monophosphate 46% P₂O₅ at 44 kg per du. (Badran *et al.*, 2001), the fertilizers were added as a soil scattering, and micronutrient fertilizer Mikrom (Italian company CIFO) was added two weeks before flowering at a concentration of 0.5 g.l⁻¹ sprayed on the vegetative growth once in the early morning.

Statistical data analysis: analysis of variance was performed using the program SAS (2002) and compared the differences between the parameters according to the Duncan's Multiple Range Test at a 5% probability level. (Al- Rawi and Khalaf Allah, 1980).

RESULTS AND DISCUSSION

Plant height (cm): The results of the statistical analysis in Table (1) showed that the varieties varies significantly between them in the characteristic of plant height. The treatment with salicylic acid led to a significant increase in the value of this trait, reached to 121.70 cm. Spraying plants with calcium chloride in both concentrations resulted in a significant increase in plant height with increasing concentration. The largest values of plant height 126.21 cm for red cultivar plants treated with salicylic acid. The plants treated with or without salicylic acid when sprayed with calcium chloride with a concentration of 1000 mg.l⁻¹ having the most significant values. Generally, the red cultivar plants treated with salicylic acid interfered with the treatment with calcium chloride at a concentration of 1000 mg.l⁻¹ gave the largest significant values 134.83 cm.

Number of leaves (leaf.plant⁻¹): The red and violet cultivar plants recorded the largest significant values for leaf number (Table 1). Spraying plants with salicylic acid led to a significant increase in the number of leaves. Whereas the treatment with both concentrations of calcium chloride resulted in a significant increase in the number of leaves. Spraying the red cultivar plants with calcium chloride at a concentration of 1000 mg.l⁻¹ significantly increased the number of leaves. The

results showed that treatment with salicylic acid and calcium chloride at a concentration of 500 mg.l⁻¹ gave the largest significant value 8.64 leaf.plant⁻¹. In general, it can be said that the largest values 8.99 leaf.plant⁻¹ was recorded from red cultivar plants treated with calcium chloride at a concentration of 1000 mg.l⁻¹.

Table (1): Effect of spraying with different concentrations of salicylic acid, calcium chloride and their interactions in plant height (cm) and number of leaves (leaf.plant⁻¹) at flowering of three cultivars of *Gladiolus G. hortulanus*.

Cultivars	SA conc. (mg.l ⁻¹)	Calcium chloride conc. (mg.l ⁻¹)			Inter. effect of Cv. & SA	Cultivar Response
		0	500	1000		
Plant height (cm)						
white	0	101.63 j	121.56 fg	130.43 bc	117.87 c	120.57 b
	250	115.66 hi	120.96 fg	133.20 ab	123.27 b	
red	0	114.43 hi	128.76 cd	127.73 c-e	123.64 b	124.92 a
	250	117.97 gh	125.83 de	134.83 a	126.21 a	
violet	0	96.8 k	118.06 gh	124.70 ef	113.19 e	114.41 c
	250	113.03 i	115.83 hi	118.00 gh	115.62 d	
Inter. effect of Cv. & calcium chloride	white	108.65 e	121.26 c	131.81 a	Effect of SA	
	red	116.20 d	127.30 b	131.28 a		
	violet	104.93 f	116.95 d	121.35 c		
Inter. effect of SA & calcium chloride	0	104.30 d	122.80 b	127.62 a	118.24 b	
	250	115.55 c	120.87 b	128.67 a	121.70 a	
Effect of calcium chloride		109.92 c	121.83 b	128.15 a		
Number of leaves (leaf.plant⁻¹)						
white	0	6.08 d	6.97 cd	6.99 cd	6.68 b	7.58 b
	250	7.77 a-c	8.95 a	8.73 a	8.48 a	
red	0	7.01 cd	8.31 a-c	8.99 a	8.10 a	8.23 a
	250	8.18 a-c	8.33 a-c	8.59 ab	8.36 a	
violet	0	8.11 a-c	8.22 a-c	8.29 a-c	8.20 a	8.16 a
	250	8.51 ab	8.65 a	7.18 b-d	8.11 a	
Inter. effect of Cv. & calcium chloride	white	6.92 c	7.96 ab	7.86 a-c	Effect of SA	
	red	7.59 bc	8.32 ab	8.79 a		
	violet	8.31 ab	8.43 ab	7.74 bc		
Inter. effect of SA & calcium chloride	0	7.06 c	7.83 b	8.09 ab	7.66 b	
	250	8.15 ab	8.64 a	8.17 ab	8.32 a	
Effect of calcium chloride		7.61 b	8.24 a	8.13 a		

*Numbers under the same letter or similar letters do not have significant differences according to

Duncan's polynomial test at a probability level of 5%.

Duration from cultivation to the inflorescence bud initiation (day): The results in Table (2) showed that the violet cultivar plants were initiated inflorescence bud significantly early compared with the red and white cultivar plants. The treatment with salicylic acid led to a significant early of inflorescence bud initiation. The data also indicated that spraying plants with calcium chloride at both concentrations resulted in significant inflorescence bud initiation in a short period. Violet cultivars recorded the lowest duration from cultivation until the emergence of inflorescence bud when sprayed with calcium chloride at a concentration of 1000 mg.l⁻¹ reached to 68.501 days. Altogether, the white cultivar plants treated with salicylic acid with calcium chloride at a concentration of 1000 mg.l⁻¹ recorded a significant decrease in the duration from cultivation until the emergence of inflorescence bud by 18.546%.

Table (2): Effect of spraying with different concentrations of salicylic acid, calcium chloride and their interactions in the duration from cultivation to the inflorescence bud initiation (day) for three cultivars of *Gladiolus G. hortulanus*.

Cultivar s	SA conc. (mg.l ⁻¹)	Calcium chloride conc. (mg.l ⁻¹)			Inter. effect of Cv. & SA	Cultivar Response
		0	500	1000		
white	0	77.704 bc	73.014 d-f	70.341 e-g	73.687 b	72.176 b
	250	73.001 d-f	71.671 e-g	67.341 g	70.671c	
red	0	82.674 a	78.008 bc	71.334 e-g	77.339 a	77.005 a
	250	79.668 ab	76.341b-d	74.008 c-e	76.673 a	
violet	0	72.335 d-f	69.669 e-g	68.668 fg	70.224 c	70.025 c
	250	71.002e-g	70.148e-g	68.333 fg	69.828 c	
Inter. effect of Cv. & calcium chloride	white	75.353 bc	72.343 cd	68.841 ef	Effect of SA	
	red	81.171 a	77.174 b	72.671 cd		
	violet	71.668 de	69.909 d-f	68.501 f		
Inter. effect of SA & calcium chloride	0	77.571 a	73.564 b	70.115 c	73.749 a	
	250	74.557 b	72.720 b	69.894 c	72.390 b	
Effect of calcium chloride		76.064 a	73.141 b	70.004 c		

*Numbers under the same letter or similar letters do not have significant differences according to Duncan's polynomial test at a probability level of 5%.

The date of flowering start, end and duration (day): The data in Table (3) indicate that the white cultivar plants were start to flowering early compared with

the other varieties. The treatment with salicylic acid led to a delay in the start of flowering date, especially when it interacts with calcium chloride in both concentrations. In general, plants treated with calcium chloride led to early flowering compared with plants not sprayed with it. The time required for the plants to end flowering was reduced when sprayed with salicylic acid and calcium chloride when compared the data for each cultivar separately. It is noted that the shortest flowering duration was for the violet cultivar when its plants were sprayed with salicylic acid and calcium chloride at a concentration of 1000 mg.l^{-1} , which ended its flowering 5 days after flowering began.

Table (3): Effect of spraying with different concentrations of salicylic acid, calcium chloride and their interaction on the date of flowering start, end and duration (day) for three cultivars of *Gladiolus G. hortulanus*.

Cultivar s	SA conc. (mg.l^{-1})	flowering start& end	Calcium chloride conc. (mg.l^{-1})		
			0	500	1000
white	0	Start- end	27June–4July	23June–30June	22June–29June
		Duration	7	7	7
	250	Start- end	26June- 4July	25June–1July	24June–30June
		Duration	8	6	6
red	0	Start- end	30June-21July	25June–12July	23June–10July
		Duration	21	17	17
	250	Start- end	3July–15July	29June–10July	26June–7July
		Duration	12	11	11
violet	0	Start- end	2July–21July	30June–15July	24June–4July
		Duration	19	15	10
	250	Start- end	3July–15July	2July–10July	2July–7July
		Duration	12	8	5

The length of the inflorescence (cm): The data in Table (4) indicate that the length of the inflorescence varied significantly due to the cultivar, with the longest being recorded at 70.14 cm for the white cultivar plants. Spraying plants with calcium chloride with both concentrations caused a significantly increased the inflorescence length. The results indicate that the largest mean values of 71.75 and 68.54 cm were recorded for inflorescences of the white cultivar plants when treated or not treated with salicylic acid, respectively. The values of all the interaction between salicylic acid and calcium chloride were significantly different with the control reached 59.58 cm. In summary, the largest values of the inflorescences lengths were obtained from plants of the white cultivar treated with salicylic acid interact with spraying with calcium chloride at a concentration of 1000 mg.l^{-1} or without it.

Classification of the length of the inflorescence without the light stand (degree): The data in Table (5) show that the values of all three interferences are confined between the standard and the special degrees

Classification of the inflorescence according to rachis length (degree): The data in Table (5) showed that the values of all three interactions are confined between the standard and the special degrees. All the varieties that were sprayed with salicylic acid or did not spray interact with calcium chloride at 1000 mg.l⁻¹ had produced a special flowers except for the violet cultivar rachis that were sprayed with salicylic acid interfered with calcium chloride 1000 mg.l⁻¹. The red and violet cultivar plants sprayed with salicylic acid produced special rachis. In general, plants when not spraying with used calcium chloride concentrations that led to the production of inflorescences that fall within the standard degree more, while the inflorescences classified within the specific degree increased with an increase in the concentration of calcium chloride up to the concentration of 1000 mg.l⁻¹.

Table (4): Effect of spraying with different concentrations of salicylic acid, calcium chloride and their interactions on the length of the inflorescence (cm) of three cultivars of *Gladiolus G. hortulanus*.

Cultivars	SA conc. (mg.l ⁻¹)	Calcium chloride conc. (mg.l ⁻¹)			Inter. effect of Cv. & SA	Cultivar Response
		0	500	1000		
white	0	62.92 c-g	68.85 a-e	73.85 a	68.54 a	70.14 a
	250	70.37 a-d	70.66 a-c	74.22 a	71.75 a	
red	0	61.00 e-h	65.69 b-e	57.44 f-h	61.37 b	62.46 b
	250	62.11 d-h	63.22 b-g	65.33 b-f	63.55 b	
violet	0	54.81 h	62.66 c-h	68.85 a-e	62.11b	63.21 b
	250	65.48 b-f	71.25 a-b	56.22 gh	64.32 b	
Inter. effect of Cv. & calcium chloride	white	66.64 bc	69.75 ab	74.03 a	Effect of SA	
	red	61.55 cd	64.45 b-d	61.38 cd		
	violet	60.14 d	66.96 bc	62.53 cd		
Inter. effect of SA & calcium chloride	0	59.58 b	65.73 a	66.71 a	64.01 b	
	250	65.98 a	68.38 a	65.25 a	66.54 a	
Effect of calcium chloride		62.78 b	67.05 a	65.98 a		

*Numbers under the same letter or similar letters do not have significant differences according to Duncan's polynomial test at a probability level of 5%.

Vase life (day): The results indicate that the inflorescences of the red and violet cultivars remained significantly longer period in vase for 5.726 and 5.816 days in good condition. Treatment with salicylic acid significantly increased the vase life of the inflorescences. Spraying with calcium chloride with both concentrations significantly increased vase life compared with control (Table 6). On the other

hand, significant differences were recorded between the interaction values of the cultivar and the calcium chloride concentrations, the longest vase life 6.555 days for the violet cultivar inflorescences sprayed with calcium chloride at a concentration of 1000 mg.l⁻¹. The results showed that the inflorescences obtained from the violet cultivar plants gave a significant increase of the vase life period when not treated or treated with salicylic acid interacting with calcium chloride at 1000 mg.l⁻¹ which reached 48.6 and 53.8% respectively.

Table (5): Effect of spraying with different concentrations of salicylic acid, calcium chloride and their interactions in classifying the inflorescence according to rachis length (degree) as the American Association of Gladiolus measurements for three cultivars of *Gladiolus G. hortulanus*.

Cultivars	SA conc. (mg.l ⁻¹)	Calcium chloride conc. (mg.l ⁻¹)		
		0	500	1000
white	0	Standard	Special	Special
	250	Standard	Special	Special
red	0	Standard	Standard	Special
	250	Special	Special	Special
violet	0	Standard	Special	Special
	250	Special	Standard	Standard

* Special (second-degree flowers), Standard (third-degree flowers).

Table (6): Effect of spraying with different concentrations of salicylic acid, calcium chloride and their interactions in vase life (day) for three cultivars of *Gladiolus G. hortulanus*.

Cultivars	SA conc. (mg.l ⁻¹)	Calcium chloride conc. (mg.l ⁻¹)			Inter. effect of Cv. & SA	Cultivar Response
		0	500	1000		
white	0	4.334 h	5.111 e-h	5.851 a-e	5.099 c	5.325 b
	250	5.215 d-g	5.518 b-f	5.925 a-e	5.552 b-c	
red	0	4.555 gh	5.777 a-f	6.073 a-d	5.468 c	5.726 a
	250	5.444 c-g	6.110 a-d	6.399 ab	5.984 ab	
violet	0	4.889 f-h	5.341 c-g	6.444 a	5.558 bc	5.816 a
	250	5.315 d-g	6.241 a-c	6.666 a	6.074 a	
Inter. effect of Cv. & calcium chloride	white	4.774 d	5.314 cd	5.888 bc	Effect of SA	
	red	4.999 d	5.944 b	6.236 ab		
	violet	5.102 d	5.791 bc	6.555 a		
Inter. effect of SA & calcium chloride	0	4.592 c	5.409 b	6.123 a	5.375 b	
	250	5.324 b	5.956 a	6.330 a	5.870 a	

Effect of calcium chloride	4.958 c	5.683 b	6.226 a	
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*Numbers under the same letter or similar letters do not have significant differences according to Duncan's polynomial test at a probability level of 5%.

The data in Table (1) showed that the plants of the red cultivar recorded the greatest values of the height, the varieties differed significantly between them. This result is consistent with Azimi and Banijamali (2019) in their study on the *Gladiolus grandiflorus* plants for five cultivars. It may be related to the competitiveness of the cultivar of light, nutrition and ventilation (Karavadia and Dhaduk, 2002). Significant differences were recorded between the cultivars in the number of leaves (Table 1), this increase in the number of leaves stimulated photosynthesis and the accumulation of carbohydrates (Jozghasemi *et al.*, 2015). It appeared from the data in Table (2) that the cultivars varied in the duration of the emergence of the inflorescence bud and the violet cultivar recorded the lowest duration to inflorescence bud initiation, this may be due to the presence of large differences between the genes, as the interaction between genes with many climatic factors affect to inflorescence bud initiation (Arora and Sharma, 1991). From the data in Table (3) of the date of flowering start, end and duration, it was observed that the white cultivar is start flowering early compared to the other two cultivars, this may be due to its early emergence of corm (unpublished results), while the violet cultivar recorded the shortest duration of flowering, the interaction of each cultivar varies with surrounding environment according to its genotype, and sprayed catalysts affected the plant response and its reflection on the start flowering and duration.

On the other hand, the results indicated in Table (4) that the length of the inflorescence was the maximum in the plants of the white cultivar, which may be due to the genetic factors of cultivar. This was confirmed by Sindhu *et al.* (2014) in their study of *Gladiolus grandiflorus*, who noted differences in the length of the inflorescence between different cultivars according to the genotypes whose character appears from one generation to another. The data in Table (5) concerning to classification of the rachis length, that the red and white cultivars were distinguished by recording the largest number of rachis classified under the Special classification (second-degree flowers), while the violet cultivar recorded the largest number of rachis under the standard classification (third-degree flowers), this may be due to their genetic makeup or by the interaction between factors studied. Table (6) data indicated that the longest vase life was recorded for the inflorescences of the violet and red cultivars, which coincided with the largest number of leaves and consequently the largest stock of food (Table 1). The difference in vase life between different cultivars may explain several possible causes: an imbalance in the hormonal content of cytokinins and gibberellins (El-Saka, 2002), or it may be due to the different flower content of soluble sugars (Kuiper *et al.*, 1995), or according to anatomical differences (Drennan *et al.*, 1986). In addition, the short vase life may be related with ethylene production and its sensitivity may be attributed to it among the different cultivars (Muller *et al.*, 1998). In this direction, the amount of water

lost by transpiration was included as one of the causes of the water imbalance of the flower that leads to the short flowering life and supports this trend Ueyama and Ichimura (1998).

Treatment with salicylic acid showed a stimulating effect on the vegetative growth characteristics of the *Gladiolus* plant, such as the plant height, which is the result of biochemical changes in the plant. The treatment with salicylic acid recorded a significant increase in the plant height (Table 1). This is likely due to the participation of salicylic acid in the cell division process and its rapid elongation due to the synergy between phenol and auxin (Padmapriya and Chezhiyan, 2002), This result is consistent with what Sewedan *et al.* (2018) mentioned on *Gladiolus grandifloras* plants. The treatment of plants with salicylic acid resulted in a significant increase in the number of leaves per plant (Table 1). In the same direction, Anwar *et al.* (2014) recorded an increase in the number of leaves of Tuberose plants when treated with salicylic acid and attributed this to the ability of salicylic acid to enhanced chemical reactions as it accelerates the divisions in the apical part of the buds. Hussein *et al.* (2007) agreed that salicylic acid has the potential to increase the efficiency of photosynthesis and to stimulate increased biosynthesis of proteins and increase the carbohydrate content when added as a spray to the vegetative growth. The data in Table (2) indicates that treatment with salicylic acid was significantly decreased duration from planting to the inflorescence bud initiation, this may explain to its role in stimulating flowering in synergist with active growth regulator such as gibberellic acid, Khobragade *et al.* (2019) agreed in their study on the African marigold. The data in Table (4) indicate a significant increase in the length of the inflorescence, this may be due to the positive effect of salicylic acid on the plant's biomass and its reflection on the flowering traits.

On the other hand, the results indicate that treatment with salicylic acid led to a significant increase in vase life (Table 6), the cause of this result is the effect of vegetative growth, and the positive synergy between auxin and salicylic acid, in addition to the role of salicylic acid in the regulation of many physiological, biochemical and molecular mechanisms related to flower senescence (Mayak and Halevy, 1980). It may explain the prolonged vase life according to its ability to alter, and maintain the biophysical properties of cell membranes (Khobragade *et al.*, 2019). Salicylic acid stops the senescence-enhancing genes (Morris *et al.*, 2000). Salicylic acid plays a role in regulating the water content of the cell by controlling transpiration pathways and maintaining the pressure of filling the leaf and petal cells (Mori *et al.*, 2001).

The data in Table (1) indicated that spraying plants with calcium chloride at a concentration of 1000 mg.l⁻¹ resulted in a significant increase in plant height, Taiz and Zeiger (2002) mentioned that calcium plays an important role in cell division that leads to a doubling of the genetic material and consequently the number of cells, this result is consistent with Nagamani *et al.* (2017) on *Gladiolus* plant. The data in Table (2) indicated a significant decrease in the period from planting to the inflorescence bud initiation when treated with calcium chloride at a concentration of 1000 mg.l⁻¹. The data in Table (4) indicate a significant increase in the inflorescence

length when treating at both concentrations of calcium chloride, and the data in Table (5) showed an increase in inflorescences classified within the specific degree (second-degree flowers) with an increase in the concentration of calcium chloride up to a concentration of 1000 mg.l^{-1} . This result in an agreement by Fukai and Uehara (2006) on the *Antirrhinum majus*, and Hamayl *et al.* (2016) on the *Dahlia pinnata*.

The results may be explain according to the role of calcium in maintaining the structure and function of the cell wall, and it is one of the most important components for strength, durability, stiffness and resistance to cell walls, as the mechanical resistance is closely related to the cell walls content of calcium linked with pectin (Hepler and Winship, 2010). The results indicated in Table (6) that the vase life was at its maximum when treated with calcium chloride at a concentration of 1000 mg.l^{-1} , this may explain that the calcium treatment led to maintaining the integrity of the cell membrane and thus delaying the electrolyte leakage which is a reliable indication of senescence of the cell membrane (Mortazavi *et al.*, 2007). It was noted from the data in Table (3) that calcium chloride resulted in start flowering early and a shortening of the flowering duration, especially when using high dose of calcium chloride, the reason for this may be due to the act of calcium mentioned above in maintaining cell viability and its role as a secondary messenger in Stimulating early flowering.

تأثير الرش الورقي لكلوريد الكالسيوم و حامض السالسليك في صفات النمو الخضري والزهري لثلاثة

أصناف من الكلاديولس *Gladiolus X hortulanus* L.

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الخلاصة

نُفذت هذه التجربة في ظللة الشبكة الخضراء التابعة لقسم البستنة وهندسة الحدائق في كلية الزراعة والغابات للمدة من نيسان 2019 ولغاية ايلول 2019، بهدف تقييم إستجابة ثلاثة أصناف من الكلاديولس *Gladiolus X hortulanus* L. للمعاملة بحامض السالسليك بتركيز صفر و 250 ملغم.لتر⁻¹ والمعاملة بكلوريد الكالسيوم بالتراكيز: صفر و 500 و 1000 ملغم.لتر⁻¹ رشاً على المجموع الخضري مرتين. أُستخدم في تنفيذ البحث التجربة العاملية بتصميم القطاعات العشوائية الكاملة. وقد أشارت النتائج إلى أن الصنف الأحمر Espresso كون أكبر إرتفاع للنبات وعدد الأوراق وأقصر مدة من الزراعة إلى نشوء البرعم النوري وأطول عمر مزهري، وسُجل الصنف الأبيض Break of dawn أكبر القيم لطول النورة مع الحامل النوري. وكان لرش النباتات بحامض السالسليك تأثير معنوي في تسجيل أكبر القيم لجميع الصفات المدروسة بإستثناء المدة من الزراعة إلى نشوء البرعم النوري فقد قلت معنوياً. وأدت المعاملة بكلوريد الكالسيوم بكلا تركيزيه إلى

زيادة معنوية في عدد الأوراق وطول النورة مع الحامل النوري، في حين سجلت المعاملة بالتركيز 1000 ملغم.لتر⁻¹ أكبر القيم لارتفاع النبات والعمر المزهري. أوضحت قيم التداخلات الثلاثية بين العوامل موضوع الدراسة عند تصنيف الأزهار وفقاً للجمعية الأمريكية للكلاديولس، أن نباتات الصنفان الأحمر والأبيض قد أنتجت أزهاراً تقع ضمن تصنيف Special وفقاً لتصنيف طول النورة بدون الحامل النوري عندما رُشّت بحامض السالسليك أو لم ترش متداخلاً مع الرش بكلوريد الكالسيوم بتركيز 1000 ملغم.لتر⁻¹، وقد انتهت نباتات الصنف البنفسجي Blue frost إزهارها بعد 5 أيام من بدء الإزهار عندما رُشّت بحامض السالسليك مع كلوريد الكالسيوم بتركيز 1000 ملغم.لتر⁻¹.

الكلمات الدالة: الكالاديولس، كلوريد الكالسيوم، حامض السالسليك، أصناف.

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