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EFFECT OF SPRAYING WITH BORON, ZINC AND SOAKING WITH GIBBERELLIC ACID AND PACLOBUTRAZOL IN SOME FLOWERING TRAITS, CORMS AND CORMELS YIELD FOR *GLADIOLUS HYBRIDA* PLANT (TRADERHORN CULTIVAR)

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Abstract

The study was conducted in the non-heated plastic house belonging to Department of Horticulture and Landscaper gardening, Collage of Agriculture and Forestry, University of Mosul, Iraq for the period from January 2013 to August 2013 on Gladiolus hybrida plants (Traderhorn cultivar). The corms were soaked with Gibberellic acid (GA3) at a concentration of (100 mg.L^{-1}) for 24 hours or soaking with paclobutrazol at concentration of (50 mg.L^{-1}), for 10 min before cultivating, the plants were sprayed with Boric acid (17% Boron) at two concentrations of (0, 30 mg.L^{-1}), with the chelated zinc of (11% zinc) at three concentrates of (0, 30, 60 mg.L^{-1}). The spraying process was conducted in two batches when the second leaf appears and at the beginning of the emergence of flower stalk. A factorial experiment was used in the conducting the research according to Complete Randomized Blocks Design with the split plot system. The results showed that the spraying with boron or zinc or soaking with Gibberellic acid had a significant effect on increasing the length of flower stalk, number of florets, vase life, diameter of corms, number of cormels, Concentration of chlorophyll in leaves, The concentration of zinc at the concentration of (60 mg.L^{-1}) was significantly excelled on the concentration of (30 mg.L^{-1}) for all studied traits, as for the soaking with paclobutrazol gave a significant increase in the number of florets, vase life, diameter of corms, number of cormels, Concentration of chlorophyll in leaves, which led to significant reduction in the length of flower stalk, A significant increase in most of the studied traits was observed in the bi-interactions. There were significant differences in most of the studied traits in the triple interaction when spraying with boron at a concentration of (30 mg.L^{-1}) with spraying at a concentration of (60 mg.L^{-1}) zinc mixed with Gibberellic acid or paclobutrazol, The number of cormels increased with percentage amounted of (143.13%) when paclobutrazol was mixed with both boron and zinc at a concentration of (60 mg.L^{-1}).

Key words : Gladiolus, Boron, Zinc, Gibberellin, paclobutrazol, phytohormones.

Introduction

Gladiolus belongs to Iridaceae family, it is derived from the Latin word Gladiolus, This is due to the fact that the shape of the leaves in the form of a sword (Ramzan *et al.,* 2010), the original home of the Gladiolus is the strains from South Africa and contains about (250 - 300 species), more than ten thousand cultivars and for more than two thousand years, it was possible to identify the growing Gladiolus cultivars in the Asia fields, It was called Corn lilies, Gladiolus cultivars are different in color, shapes and sizes compared to other flowering plants (Dole and Harold, 2005; Gauchan *et al.,* 2009). It has an important position among commercial flowers and has a growing demand in world markets, it occupied eighth position in global cut flowers trade (Ahmad *et al.,* 2008). Boron (B^{+1}) is considered from an essential micronutrient to plant growth and needs small quantities, It facilitates the transfer of carbohydrates and helps to stimulate the division and formation of plant cells. It also stimulates the formation of phenolic compounds and nucleic acids. It regulates the activity of hormones and enzymes in addition to its role in the process of inoculation of the flower, structure, stiffness and maintenance of the cell wall and maintenance of plasma membrane function (Sellappan and Manickam, 2013), Zinc (Zn^{+2}) is considered an essential micronutrient for plant growth and development it, Contributes to the formation of the

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pollen tube, It acts as a regulator for the cell's pH, helps the elongation of the stem and stimulates the work of growth regulator (Auxin), the formation of amino acid (Tryptophan), which in turn affects the activity of growth regulator, stimulates the formation of Cytochrome and maintains the stability of parts of the Ribosome, It introduces in metabolism, chlorophyll, carbohydrates and disease resistance (Al-Nuaimi, 1999; Tsonev and Fernando, 2012). Several studies have indicated to the role of natural growth regulators that have taken an increasing role in production processes, including GA3, which contributes to plant growth and development, accelerates the break-up of dormancy phase. It stimulates division, elongation and differentiation of cells, expansion of leaf area, increase wall flexibility, overcoming genetic dwarfism, growth of the pollen tube and its effect on metabolism (Fleet and Tai, 2005; Yamaguchi, 2008). Paclobutrazol (PP333) is a growth inhibitory and inhibits the action of Gibberellic acid and prevents longitudinal elongation of cells, leading to increase the concentration of chlorophyll in the leaves, increase the thickness of the leaf and Working on resistant of drought and fungal diseases (David *et al.,* 2002; Sebastian *et al.,* 2002). Sharma *et al.,* (2013) reported that zinc spraying (zinc sulphate) with concentration of (0, 0.75%), boron (0, 0.2%) and calcium (0, 0.5%) on Gladiolus plants, the interaction between them gave the best results in plant height, number of leaves, number of flowers, number of corms and the length of flower stalk and the longest vase life on the plant, Halder *et al.,* (2007a) observed when adding of boron fertilizer with concentrations of (0, 1, 2, 3 $kg.ha^{-1}$), zinc fertilizer with concentrations of (0, 1.5, 3, 4.5 $kg.ha^{-1}$) on the Gladiolus plant led to a significant increase in plant height and length of flower stalk, the number of leaves and the number of florets, the diameter of florets and the weight of flower stalk and that the best interaction was between the concentration of boron (2 $kg.ha^{-1}$) and zinc (3 $kg.ha^{-1}$), Halder *et al.,* (2007 b) showed that the Gladiolus plant was fertilized with four levels of boron (0, 1, 2, 3 $kg.ha^{-1}$) and four levels of zinc (0, 1.5, 3, 4.5 $kg.ha^{-1}$). It was during land preparation which led to obtain the best significant results for the traits of the largest weight of corms and cormels, the largest number of corms and cormels that are formed for each plant, and the best concentration of boron (2 $kg.ha^{-1}$) with zinc (4.5 $kg.ha^{-1}$). Mahshid, (2012) noted that the foliar spraying with three levels (0, 0.5, 1 %) of zinc sulphate ($ZnSO_4$) and Iron (II) sulfate ($FeSO_4$) that sprayed on Gladiolus plants (Oscar cultivar) twice when the second and the sixth leaves were appeared, It was found that 1% concentration of zinc sulphate or and Iron(II) sulfate ($FeSO_4$) caused a significant increase in vegetative and flowering growth traits, Singh *et al.,* (2012) found that the foliar spraying with zinc (0.5%) on the Gladiolus plant significantly affected on the increase in the diameter and number of corms, The spraying with zinc and copper to an increase in the weight of corms, the number of cormels increased when spraying with zinc, copper and iron. Shrma *et al.,* (2004) reported that spraying of zinc sulphate on the leaves of the Gladiolus plant (Friendship White cultivar) at a concentration of 0.6 %, led to an increase in plant height, the length of flower stalk, number of florets in the flower stalk, number of corms and cormels for plant. Khalife *et al.,* (2011) reported that the effect of foliar spraying with zinc, boron and their interactions, where Iris plants that cultivated in flowerpots into lath house were sprayed twice, the first one after 45 days and the second one after 60 days of cultivating with four concentrations of boron (0, 5, 10, 20 $mg.L^{-1}$) and four concentrations of zinc (0, 1.5, 3, 4.5 $mg.L^{-1}$), led to increase the traits of flower growth and number of bulbs / plant, increase in the leaves and flowers content of carbohydrates, chlorophyll and nutrients, compared to the control treatment. Faraji and Tayebe, (2013) reported an experiment with the soaking of the Gladiolus plant (Prosperity White) with three concentrations of (50, 100, 150 $mg.L^{-1}$) for six hours in addition to the control treatment before cultivating, the concentration (100 $mg.L^{-1}$) was caused a significant increase in the diameter and length of flower stalk, The number of florets, and the longest vase life in the concentration of (50 $mg.L^{-1}$),

Phytohormons are the most important endogenous substances for moderating physiological and molecular responses (Al-Taey and Majid, 2018), a critical requirement for plant survival, Phytohormons act at their site of synthesis or elsewhere in plants following their transport (AL-Taey *et al.*, 2018), Dogra *et al.*, (2012) reported that the soaked Gladiolus plant at a concentration of (300 $mg.L^{-1}$) of GA3 for 24 hours before cultivation and cultivating it led to early flowering and increasing the plant height, the number of leaves, the width of the leaf, the length of the flower stalk and the diameter of the corms and its weight. Amin, (2009) indicated to that the cultivating of iris plant (iris hollandica) and spraying it with paclobutrazol at concentrations of (0, 10, 20, 40, 80 $mg.L^{-1}$), with two spraying, Treatment with paclobutrazol led to a decrease in plant height and the lowest height occurred at concentration of (80 $mg.L^{-1}$). The concentration (10 $mg.L^{-1}$) gave the highest increase in the leaves content of chlorophyll and diameter of flower stalk, a concentration of (40 $mg.L^{-1}$) gave increase in the diameter of the floret and a concentration of (80 $mg.L^{-1}$) gave an increase in dry weight of flowers, the number of

bulbs, diameter of bulbs and dry weight of bulbs compared to non-treated plants.

Materials and Methods

The study was conducted in the non-heated plastic house belonging to Department of Horticulture and Landscaper gardening, Collage of Agriculture and Forestry, University of Mosul, Iraq for the period from January 2013 to August 2013 on Gladiolus hybrida plants (Traderhorn cultivar) to study the effect of spraying with boric acid (H_3BO_3) containing two concentrations: (0, 30 mg.L^{-1}), The spraying with chelated zinc was conducted with three concentrations of (0, 30, 60 mg.L^{-1}). The spraying process was conducted twice: the first one when the second leaf appeared due to the emergence of the flowering buds and the second one at the beginning of the emergence of flower stalk (Mahshid, 2012). Tween 20 was added to spraying solutions to increase its spread on the surfaces of the plant leaves, croms were soaked with Gibberellic acid (GA3) at a concentration of (100 mg.L^{-1}) for 24 hours before cultivating or the corms soaked of the Gladiolus plant with Paclobutrazol (PP333) at a concentration of (50 mg.L^{-1}) for ten minutes before cultivating and left the control treatment without soaking. The plastic house was prepared by cleaning, weeding, thicket Grubbing, making furrows between the furrow and another is 25 cm, between corm and another is 30 cm, with the depth of 10 cm (Sudhakar and Ramesh, 2012). The imported corms from Netherlands were cultivated directly after the soaking on 25/February/2013, which their diameters are 4-5 cm inside the plastic house for Traderhorn cultivar. The color of their flowers is red inside it the white color, and on the two sides of furrow contains three replicates, with rate of six corms for the experimental unit. Irrigation was conducted when the surface soil is dry and the weeding and Grubbing were conducted between time to time during the study period whenever needed, with the ventilation of the house by raising half of the plastic cover on 1/4/2013. The decomposed organic fertilizer (sheep manure) was added when preparing the soil for cultivation, with ratios of 5 soil: 1 organic fertilizer: 1 peat moss, be in the form of pieces with dimensions of (30 x 30) and thickness of 12 cm, chemical fertilizer was added. The traits of the length of the main flower stalk, the number of flowers on the main flower stalk, the vase life (day), the diameter of the corms / plant (cm), the number of formed cormels / plant, and the leaves content of chlorophyll (SPAD) were studied. A factorial experiment was conducted according to Complete Randomized Blocks Design with the split plot system.

Results and Discussion

Length of main flower stalk (cm)

Table 1 showed that there were significant differences in spraying with boron at a concentration of (30 mg.L^{-1}) which gave a significant increase in the length of flower stalk amounted of (92.78 cm) compared to the control treatment which gave (90.97 cm), The spraying with zinc at concentrations of (30, 60 mg.L^{-1}) has a significant effect on this trait, which gave (91.89, 93.11 cm), respectively, by excelling it significantly on the control treatment which gave (90.62 cm). The spraying treatment with growth regulators showed significant effect where recorded the highest values for this when treating with Gibberellic acid at a concentration of (100 mg.L^{-1}) which amounted of (94.22 cm) and differed significantly when treating with Paclobutrazol at concentration of (50 mg.L^{-1}) which recorded the lowest values in the length of flower stalk 90.17 cm and significantly different with the control treatment which amounted of 91.24 cm. The bi-interaction data between the boron and zinc showed a significant increase in the length of the main flower stalk at a concentration of (30 mg.L^{-1}, 60 mg.L^{-1}), where the length of main flower stalk amounted of (94.01 cm) which significantly excelled on the control treatment (89.97 cm), Bi-interaction between zinc and growth regulators showed a significant effect in this trait amounted of (95.80 cm) when spraying with zinc at a concentration of (60 mg.L^{-1}) and Gibberellic acid significantly higher than the treatment of Paclobutrazol, non-treating with zinc and the control treatment which recorded (90.36 cm), As for Interaction between boron and growth regulators, the spraying with boron at a concentration of 30 mg.L^{-1}) and Gibberellic acid gave the longest main flower stalk amounted of (95.34 cm) and significantly excelled on the control treatment, which gave 90.55 cm. On the other hand, the treatment with Paclobutrazol recorded significantly the lowest values, which amounted of (89.26 cm) for non-treatment with boron. The combined effect for the studied factors showed a significant effect in this trait. The longest flower stalk amounted of (96.90 cm), The soaked corms with Paclobutrazol and spraying with (30 mg.L^{-1}) Boron and (60 mg.L^{-1}) Zinc gave (88.30 cm) compared to the control treatment which amounted of 89.90 cm.

Number of florets on the main flower stalk

Table 2 shows a significant effect for spraying with boron in the trait of the number of florets on the main flower stalk, where a concentration of (30 mg.L^{-1}) boron was excelled which gave (20.45 floret) and the lowest average amounted (19.19 floret) for the control treatment,

Table 1: Effect of Boron, Zinc, Gibberellic acid, Paclobutrazol and their interactions in average length of flower stalk (cm) for Gladiolus plant (Traderhorn cultivar).

Concentration of boron (ml.L^{-1})	Concentration of Zinc (ml.L^{-1})	Growth regulators (ml.L^{-1})			Interaction between Zinc and boron	Average of boron
		0	$GA_3$100	PP_{333}50		
0	0	89.90j-l	91.73gh	88.30m	89.97f	90.97b
	30	90.33jk	92.87d-f	88.97lm	90.72e	
	60	91.43g-i	94.70c	90.53i-k	92.22c	
30	0	90.83h-j	93.37d	89.63j-l	91.27d	92.78a
	30	91.97fg	95.77b	91.47g-i	93.07b	
	60	93.00d	96.90a	92.13e-g	94.01a	
Interaction between boron and growth regulators	0	90.55e	93.10b	89.26f	Average of zinc	
	30	91.93c	95.34a	91.07d		
Interaction between Zinc and growth regulators	0	90.36e	92.55c	88.96f	90.62c	
	30	91.15d	94.32b	90.22e	91.89b	
	60	92.21c	95.80a	91.33d	93.11a	
Average growth regulators		91.24b	94.22a	90.17c		

* Values with similar characters for each factor or their interactions individually did not differ significantly according to the Duncan Multiplicity test below the 5% probability level.

Table 2: Effect of Boron, Zinc, Gibberellic acid, Paclobutrazol and their interactions in average number of florets on the main flower stalk for Gladiolus plant (Traderhorn cultivar).

Concentration of boron (ml.L^{-1})	Concentration of Zinc (ml.L^{-1})	Growth regulators (ml.L^{-1})			Interaction between Zinc and boron	Average of boron
		0	$GA_3$100	PP_{333}50		
0	0	18.00j	19.11g-i	18.66i	18.59f	19.19b
	30	18.55ij	19.44fg	18.77hi	18.92e	
	60	19.33gh	20.88c	20.00ef	20.07c	
30	0	19.00g-i	20.00ef	19.33gh	19.44d	20.45a
	30	20.00ef	21.00b	20.66cd	20.73b	
	60	20.22de	22.33a	21.00bc	21.18a	
Interaction between boron and growth regulators	0	18.62e	19.81c	19.14d	Average of zinc	
	30	19.74c	21.29a	20.33b		
Interaction between Zinc and growth regulators	0	18.50f	19.55cd	18.99e	19.01c	
	30	19.28de	20.49b	19.72c	19.83b	
	60	19.77c	21.60a	20.50b	20.62a	
Average growth regulators		19.18c	20.55a	19.73b		

* Values with similar characters for each factor or their interactions individually did not differ significantly according to the Duncan Multiplicity test below the 5% probability level.

The spraying with zinc at concentrations of (30, 60 mg.L^{-1}) gave the highest number of florets amounted of (19.83, 20.62 floret) on the main flower stalk, respectively, and significantly excelled on the control treatment, which amounted to (19.01 floret), While treatment with growth regulators gave a number of florets on the main flower stalk when treated with Gibberellic acid and treated with Paclobutrazol which gave (20.55, 19.73 florets), respectively and significantly excelled on the control treatment which amounted of (19.18 florets). Bi-interaction between boron and zinc showed a significant effect with this trait. The value amounted of (21.18 florets) at (30 mg.L^{-1}) concentration of boron and (60 mg.L^{-1}) of Zn, which was significantly excelled on the control treatment, which amounted of (18.59 florets). The results of spraying with zinc at a concentration of (60 mg.L^{-1}) with Gibberellic acid was the greatest effect which gave the highest number of the main flower stalk gave (21.60 floret) compared to the control plants which gave (18.50 floret), As for the common interaction between spraying with boron at concentration of (30 mg.L^{-1}) with the treating by growth regulators (Gibberellic acid) gave the number of florets amounted of (21.29 floret) and varied significantly from the control treatment which gave (18.62 floret). The bi-interaction between boron, zinc and growth regulators was significantly for

Table 3: Effect of Boron, Zinc, Gibberellic acid, Paclobutrazol and their interactions in average Vase life (day)for Gladiolus plant (Traderhorn cultivar).

Concentration of boron (ml.L^{-1})	Concentration of Zinc (ml.L^{-1})	Growth regulators (ml.L^{-1})			Interaction between Zinc and boron	Average of boron
		0	$GA_3$100	PP_{333}50		
0	0	13.33g	14.66d-f	14.33e-g	14.10d	14.66b
	30	14.00fg	15.33b-e	14.66d-f	14.66cd	
	60	14.33e-g	16.00a-c	15.33b-e	15.22bc	
30	0	14.00fg	15.66a-d	15.00c-f	14.88c	15.54a
	30	14.66d-f	16.33ab	16.00a-c	15.66ab	
	60	15.33b-e	16.66a	16.33ab	16.10a	
Interaction between boron and growth regulators	0	13.88e	15.33bc	14.77cd	Average of zinc	
	30	14.66d	16.22a	15.77ab		
Interaction between Zinc and growth regulators	0	13.66e	15.16bc	14.66cd	14.49c	
	30	14.33de	15.83ab	15.33bc	15.16b	
	60	14.83cd	16.33a	15.83ab	15.66a	
Average growth regulators		14.27c	15.77a	15.27b		

* Values with similar characters for each factor or their interactions individually did not differ significantly according to the Duncan Multiplicity test below the 5% probability level.

Table 4: Effect of Boron, Zinc, Gibberellic acid, Paclobutrazol and their interactions in average diameter of corms (cm)for Gladiolus plant (Traderhorn cultivar).

Concentration of boron (ml.L^{-1})	Concentration of Zinc (ml.L^{-1})	Growth regulators (ml.L^{-1})			Interaction between Zinc and boron	Average of boron
		0	$GA_3$100	PP_{333}50		
0	0	3.98l	4.32jk	4.58h-j	4.29f	4.58b
	30	4.31k	4.66g-i	4.93ef	4.63e	
	60	4.45i-k	4.87fg	5.17c-e	4.83d	
30	0	4.62g-i	5.03d-f	5.34c	4.99c	5.30a
	30	4.79f-h	5.20cd	5.82ab	5.27b	
	60	5.27cd	5.61b	6.04a	5.64a	
Interaction between boron and growth regulators	0	4.24e	32.08d	4.89c	Average of zinc	
	30	4.89c	4.61b	5.73a		
Interaction between Zinc and growth regulators	0	4.30e	4.67d	4.96c	4.64c	
	30	4.55d	4.93c	5.37b	4.95b	
	60	4.86c	5.24b	5.60a	5.23a	
Average growth regulators	14.27c	15.77a	15.27b			

* Values with similar characters for each factor or their interactions individually did not differ significantly according to the Duncan Multiplicity test below the 5% probability level.

this trait, where the concentration of (30 mg.L^{-1}, 60 mg.L^{-1}) gave the highest number of florets on the main flower stalk which amounted of (22.33 floret) compared to the control treatment that recorded the lowest number of florets amounted of (18.00 floret).

Vase life (day)

Table 3 indicates that spraying with boron at a concentration of (30 mg.L^{-1}) led to a significant increase in vase life, which amounted of (15.54 days) and significantly different from the control treatment, which amounted of (14.66 days) compared to the control treatment amounted of (14.49 days). The treatment with growth regulators significantly differed in the vase life. The spraying treatment with Gibberellic acid was significantly excelled by in vase life, where amounted of (15.77 days), While the spraying treatment with Paclobutrazol gave (15.27 days) and significantly different with the control treatment which amounted of 14.27 days. As for the interaction between the boron and the zinc was significant in increasing the duration of the vase life. Which recorded the highest value (16.10 days) for the plants which were sprayed at a concentration of (30 mg. L^{-1}) of boron with (60 mg.L^{-1}) of zinc, the control treatment gave the lowest value amounted of (14.10 days),

Table 5: Effect of Boron, Zinc, Gibberellic acid, Paclobutrazol and their interactions in average number of cormels (cormels / plant) for Gladiolus plant (Traderhorn cultivar).

Concentration of boron ($ml.L^{-1}$)	Concentration of Zinc ($ml.L^{-1}$)	Growth regulators ($ml.L^{-1}$)			Interaction between Zinc and boron	Average of boron
		0	$GA_3$100	PP_{333}50		
0	0	17.41l	19.91jk	33.00e	23.44f	24.85b
	30	18.67kl	21.33ij	34.83d	24.94e	
	60	20.09jk	22.17hi	36.25cd	26.17d	
30	0	21.75i	23.58h	37.41c	27.58c	29.67a
	30	23.50h	26.33g	39.00b	29.61b	
	60	25.17g	28.00f	42.33a	31.83a	
Interaction between boron and growth regulators	0	81.72h	21.13e	34.69b	Average of zinc	
	30	23.47d	25.97c	39.58a		
Interaction between Zinc and growth regulators	0	19.58h	21.74fg	35.20c	25.51c	
	30	21.08g	23.83e	36.91b	27.27b	
	60	22.63f	25.08d	39.29a	29.00a	
Average growth regulators		21.09c	23.55b	37.13a		

* Values with similar characters for each factor or their interactions individually did not differ significantly according to the Duncan Multiplicity test below the 5% probability level.

Table 6: Effect of Boron, Zinc, Gibberellic acid, Paclobutrazol and their interactions in average of the leaves content of total chlorophyll for Gladiolus plant (Traderhorn cultivar).

Concentration of boron ($ml.L^{-1}$)	Concentration of Zinc ($ml.L^{-1}$)	Growth regulators ($ml.L^{-1}$)			Interaction between Zinc and boron	Average of boron
		0	$GA_3$100	PP_{333}50		
0	0	59.37m	61.10kl	62.63h-j	61.03f	62.50b
	30	61.53j-l	62.27i-k	63.93e-g	62.58d	
	60	62.70g-j	63.50e-i	65.47cd	63.89c	
30	0	60.90l	61.47j-l	63.20f-i	61.85e	64.35a
	30	63.67e-h	64.73de	67.03ab	65.14b	
	60	64.43d-f	65.97bc	67.83a	66.07a	
Interaction between boron and growth regulators	0	61.20e	62.29d	64.01b	Average of zinc	
	30	63.00c	64.05b	66.02a		
Interaction between Zinc and growth regulators	0	60.13f	61.28e	62.91cd	61.44c	
	30	62.60d	63.50c	65.48b	63.86b	
	60	63.56c	64.73b	66.65a	64.98a	
Average growth regulators		62.10c	63.17b	65.01a		

* Values with similar characters for each factor or their interactions individually did not differ significantly according to the Duncan Multiplicity test below the 5% probability level.

The bi-interaction between zinc and growth regulators has a significant effect, where the duration of vase life increased which gave the highest value amounted of (16.33 days) when the plants were sprayed with (60 $mg.L^{-1}$) of zinc and treated with Gibberellic acid compared to control treatment which gave the lowest value amounted of (13.66 days). The effect of bi-interaction between the boron and growth regulators was significant in the increase in the vase life when spraying the plants with boron at concentration of (30 mg. L^{-1}) with the treatment of Gibberellic acid amounted of (16.22 days) and also did not significantly differ with the treatment of Paclobutrazol which amounted to (15.77 days), which was significantly excelled on the control treatment (13.88 days). The triple interaction between boron, zinc and growth regulators was significantly excelled in vase life by recording it the highest value when spraying the plant with boron at a concentration of (30 $mg.L^{-1}$) zinc, (60 mg. L^{-1}) of treating with Gibberellic acid which amounted of (16.66 days), while the control treatment gave the lowest values in vase life amounted of (13.33 days).

The diameter of corms (cm)

Table 4 shows an increase in the diameter of the corms when spraying plants with boron at a concentration

of (30 mg.L^{-1}), where it amounted of (5.30 cm) to reach the significant level compared to the control treatment which amounted of (4.58 cm), the effect of spraying with zinc differed significantly where the concentrations (30, 60 mg.L^{-1}) of Zinc gave the highest significant values amounted of (4.95, 5.23 cm), respectively, while the control treatment gave the lowest values amounted of 4.64 cm, and the presence of significant differences in the diameter of the corms when treated with growth regulators, where recorded the highest significant value amounted of 5.31 cm when treating it with Paclobutrazol, while the Gibberellic acid gave 4.94 cm compared to the control treatment which recorded (4.57 cm). The bi-interaction between spraying with zinc and boron showed a significant increase in the diameter of the corms amounted of (5.64 cm) when using the concentration of (30 mg.L^{-1}) of boron and zinc at concentration of (60 mg.L^{-1}) was significantly excelled on the control treatment which gave (4.29 cm), The results showed that the zinc and growth regulators led a significant increase in the diameter of the corms, where the spraying with zinc at concentration of (60 mg.L^{-1}) and Paclobutrazol treatment gave the highest value amounted of (5.60 cm) compared to the control treatment which recorded the lowest values amounted of (4.30 cm), There was a significant superiority at the interaction of spraying treatment with boron at a concentration of (30 mg.L^{-1}) and the Paclobutrazol treatment, which amounted of (5.73 cm) while the control treatment gave 4.24 cm. It is also noted from the results of the triple interaction of the factors studied that the highest values for the diameter of the corms amounted of (6.04, 5.82 cm) when spraying the plants with boron at a concentration of (30 mg.L^{-1}) and zinc at a concentration of (60 or 30 mg.L^{-1}) with the Paclobutrazol treatment, respectively and significantly excelled on the control treatment which gave of 3.98 cm.

The number of cormels

Table 5 shows that the number of cormels was significantly different for spraying with boron at concentration of (30 mg.L^{-1}), where amounted of 29.87, While their number decreased to 24.85 at the control treatment, It is noted that Zinc has significantly excelled when spraying it at concentrations of (30, 60 mg.L^{-1}) which gave (27.27, 29.00), respectively, while the control treatment recorded 25.51, It is indicated the highest number of cormels amounted of (37.13) when treated with Paclobutrazol growth regulators which was significantly excelled on the Gibberellic acid that amounted of (25.55) and they Were significantly different with the control treatment, which gave the lowest number of cormels amounted of (21.09). Paclobutrazol led to increase, with percentage of (76.05% and 57.66%) with control and Gibberellic acid, respectively. The bi-interaction between boron and zinc was significantly excelled at concentration of (30 mg.L^{-1}) for boron and (60 mg.L^{-1}) for zinc, where the number of cormels amounted of 31.83, while the control treatment amounted of (23.44) and a significant increase occurred at the interaction between the Zn and growth regulators which recorded 39.29, with an increase of 100.66% when spraying with zinc at a concentration of (60 mg.L^{-1}) with Paclobutrazol and decreased their number at the control treatment, which gave 19.58, As for of bi-interaction between boron and growth regulators, the spraying with boron at concentration of (30 mg.L^{-1}) with Paclobutrazol treatment gave the highest number of cormels amounted of (39.58), with an increase of (111.43%) and significantly excelled on the control treatment which gave the lowest number of cormels amounted of (18.72), The results showed that there was a significant difference between the studied treatments, where recorded the highest number of cormels amounted of (42.33), with an increase of 143.13% when spraying with boron at a concentration of (30 mg.L^{-1}), spraying with boron at a concentration of (60 mg.L^{-1}) and with Paclobutrazol treatment, While it was reduced to a minimum at control treatment amounted of (17.41 cormels/ plant).

Concentration of total chlorophyll in leaves (SPAD):

Table 6 shows that spraying with boron has a significant effect on the leaves content of total chlorophyll. where The concentration (30 mg.L^{-1}) of boron gave the highest value amounted of (64.35 SPAD), thus significantly differed with control treatment by giving it (62.50 SPAD). The spraying with zinc was significantly increased the leaves content of total chlorophyll, where recorded the highest values amounted of (63.86, 64.98 SPAD) at the two concentrations of (30, 60 mg.L^{-1}), respectively, which excelled on the control treatment by giving it (61.44SPAD), However, growth regulators recorded the highest values of (65.01SPAD) when treating with Paclobutrazol which significantly excelled on the treatment of Gibberellic acid, where amounted of (63.17 SPAD) and these two values differed for the comparison treatment (62.10 SPAD). As for bi-interaction between boron and zinc, its effect was significant in the leaves content of total chlorophyll, where amounted the highest value (66.07 SPAD) when spraying with boron at a concentration of (30 mg.L^{-1}) and spraying with zinc at a concentration of (60 mg.L^{-1}), which excelled on the control treatment by giving it the lowest value amounted of (61.03 SPAD), As for interaction between zinc and growth regulators, the spraying with zinc at

concentration of (60 mg.L^{-1}) with Paclobutrazol treatment in the leaves content of total chlorophyll, which amounted of (66.65 SPAD) compared to the control treatment which gave (60.13 SPAD). Bi-interaction between boron and growth regulators showed significant differences, the highest leaves content of total chlorophyll amounted of (66.02 SPAD) when spraying with boron at a concentration of (30 mg.L^{-1}) with Paclobutrazol treatment compared to the control treatment which gave the lowest significant value 61.20 SPAD. The results of the triple interaction between boron, zinc and growth regulators showed a significant increase in the leaves content of total chlorophyll, where recorded the highest value when spraying with boron at a concentration of (30 mg.L^{-1}) and zinc with (60 or 30 mg.L^{-1}) interacting with Paclobutrazol treatment amounted to (67.83, 67.03 SPAD) and significantly excelled on the control treatment, which amounted of (59.37 SPAD).

Table 1 shows that the spraying with boron and zinc led to a significant increase in the length of the flower stalk through the role of boron in the regulation and activation of a number of enzymes, which leads to the improvement of the state of the plant in general and increase growth by stimulating the plant cells division, the importance of large in the composition Nucleic acids, as well as stimulate the bio-processes of RNA (Al-Nuaimi, 1999). Zinc causes the formation of the amino acid (Tryptophan), which is important in the production of the Auxin hormone (indole acetic acid (IAA) that necessary for division and elongation of plant cells, which enters the composition and formation of a number of different enzymes (Mousavi, 2011), The treatment of Gibberellic acid significantly led to increase the length of the flower stalk, its role in activating the cell division in the region below the Apical meristem, Which leads to the elongation of the cells, which helps in the formation and formation of the enzyme α-amylase and works mainly to convert starch to reducing sugar, Which in turn lead to increasing the Osmotic pressure in the cells of the plant and then increase the entry of water and food, causing swelling and increase their size, thus reflecting the elongation of cells (Abu Zaid, 2000), The treatment with Paclobutrazol led to reduce the length of the ember because of its role in inhibiting the production of natural Gibberellic, it is internal hormone responsible for elongation of cells (Hazarika, 2003). The results of the tables 2, 3 indicate that spraying with boron and zinc has led to an increase in the number of florets and vase life, through the role of boron in the building of carbohydrates and regulates the element of calcium and participate in the process of inoculation and fertilization, then lead to an increase in the number of flowers as well as its role in regulating the work of hormones and increase availability of nutrient elements (Nitrogen, phosphorus and potassium) that contribute to increase of dry and fresh weight and the role of boron in the formation of proteins, amino acids, manufacturing nutrient materials that helps in plant growth and contribute to the division of meristem cells (Sellappan and Manickam, 2013) and Early in flowering. The results agree with (Halder *et al.,* 2007 a) in their study on the Gladiolus plant, due to the important role of zinc in the formation of starch, which leads to increase carbohydrates in the plant, then increase the number of flowers, its role in the oxidation process leads to increasing energy in the plant and its importance in the manufacture of amino acid (Tryptophan) to form the Auxin which plays a role in the metabolism process and development of ribosomes (Mousavi *et al.,* 2013), The positive role for Gibberellic acid is due to its metabolism, the growth of the pollen tube and the increase of carbohydrates, as well as cell division and elongation it, which leads to an increase in the number of flowers (Fleet and Tai, 2005). Gibberellic acid significantly led to increase the vase life; it affects many physiological processes Such as Senescence, reducing the breaking of proteins and Chlorophyll, increasing the content of plant parts from nutrient elements, increasing of Reducing sugar in flowers that support the Osmotic pressure, improving their ability to withdraw water, maintaining swelling, reducing transpiration and maintaining the swelling of the cells (Al-Jubouri, 2012). The treating with Paclobutrazol showed significant differences in the increase in the number of flowers and the vase life due to the good vegetative growth resulting from the increase concentration of chlorophyll and the reduction of stress and tolerance to environmental conditions, which is reflected in the traits of flowering growth, this results agree with (Amin, 2009) for Iris plant. The results of the tables 4, 5 show that the reason for the significant increase in the diameter of the corms and the number of cormels is due to the importance of boron in the transfer of carbohydrate to the corms and its generation in the formation of cells as well as RNA and DNA and the reduction of nitrates in the plant and also contribute to the organization and composition of growth hormones, including cytokinines, where its role in the division and expansion of cells as well as stimulate the increase of the growth rate and the manufacture of proteins, which increased when spraying, which leads to the attraction of nutrient materials towards the roots, and this may reflect on the production and formation of corms and cormels from the accumulation of carbohydrates in them (George *et al.,* 2008; Al-mosali, 2011). The role of zinc in the formation and stimulation of a number of

enzymes, and acts as a regulator of the pH for the cell and thus prevents the change of the nature of proteins and participates in the formation of starch and enters the formation of Tryptophan, which in turn affects the activity of the regulator of growth and leads to division and elongation of cells and stimulate bio-processes (Al-Naimi, 1999). The treatment with Gibberellic acid shows its role in activating the process of cells division and elongation of and RNA formation, stimulates bio-processes within plant cells and the transfer of nutrients to the corms (Abdoul, 1987). The treatment of Paclobutrazol has led to a significant increase in the diameter of the corms and the number of cormels as a result for the improving the growth of the total vegetative, increasing the chlorophyll and may be the food balance between the used materials to prepare the plant to receive materials, manufacturing it and The effect of growth regulators and this is reflected in the increase of the traits of corms and cormels. This results agree with (Amin, 2009) in their study on the Iris plant. The results of table 6 indicate that the concentration of chlorophyll increases significantly when spraying with boron due to its role in stimulating the bio-processes, photosynthesis, enzymes, nitrate reduction and regulates the work of hormones, This agree with Al-Khalifa *et al.,* (2011) in their study on the Iris plant. The spraying with Zinc leads to a significant difference in the increase of chlorophyll, this is what Al-Mousalli, (2011) indicated that it has an important role in the construction of chlorophyll, although not entered into the composition, but it enters into the construction of enzymes responsible for the formation of chlorophyll, The treatment with alkaline acid has a role in building proteins and RNA, stimulates some enzymes and increases the photosynthesis process and delays the Senescence of leaves (Abdoul, 1987). Treatment with Paclobutrazol was significantly increased the concentration of chlorophyll as greener and contains the Triazole ring in which the nitrogen atoms that enter In the construction of chlorophyll which increases plant greenery, This is what (Petter and Jan, 1985; Al-Naimi, 1999) mentioned.

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