J. of Plant Production, Mansoura Univ., Vol. 13 (9): 691 - 697, 2022

Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Effect of Gibberellic Acid (GA_3) and Biofertilizers Application on Growth and Flowers Quality of Gladiolus Gandavensis, L. Plants

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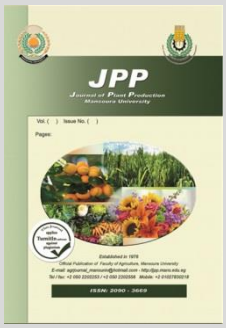

ABSTRACT

Two field experiments were designed to study the effect of gibberellic acid (GA_3) at 0, 50, 100 and 200 mgl^{-1} as pre-soaking of corms for 24 hr and bio-fertilizers [Nitrobine+Phosphorein (NP) 1:1 w/w] at rates 0.00 2.00 , 4.00 and 6.00 g/ plant). The aim of the present investigation was to evaluate the effect of gibberellic acid (GA_3) and bio-fertilization on growth, flowering and corm production of Gladiolus gandavensis L. cv. " Rosesupreme ". The obtained data showed that solo treating of gladiolus corms with GA_3, different rates of bio-fertilization and its combination stimulated the growth parameters (plant height , number of leaves/ plant and leaves fresh weight / spike), flowering parameters (numbers of days from corms planting to flowering (day), number of florets /spike, and dry weights of spike L plant),leaves total chlorophyll , total carbohydratesof dry corms and yield production of corms. It can be recommended that treating gladiolus plants with GA_3 at 200 mgL^{-1} combined 4.00 and/or 6.00 g/ plant of bio-fertilizer (Nitrobine + Phosphorein 1:1 w/w) produce great yield of gladiolus plants (flowers and corms) with high quality

Keywords: Gladiolus, flowers quality, corms, gibberellic acid (GA_3), bio-fertilizers.

INTRODUCTION

The family Iridaceae has 180 species of gladiolus, which are herbaceous plants that grow from axillary buds on a corm. The inflorescence is a spike and originates as a terminal axis (Larson, 1980).

Gladiolus is propagated both sexually by seeds for raising new varieties and asexually by corms and cormels, the last methods of propagation is the main method for producing a commercial high quality crop. Gladiolus flowers may be grown under Egyptian conditions at any time, making them available all year long. Additionally, species are naturalized widely cultivated as cut flowers crops and ornamental garden plant, the widespread production may attribute to the short growth period that taken until flowering ability to withstand long distance transportation. (Lewis, *et al*., 1972; Wilfert, 1974 and Hogan, 1990).

Gibberellins are plant growth regulators that have an impact on many aspects of plant development, such as germination, dormancy breaking, stem lengthening, flowering, enzyme induction, sex expression, and senescence of the leaves and fruits. Maximum plant height, number of flowers and leaves, leaf area and flowering, chlorophyll content, yield and quality in various flowering crops, and increase in vase life were all measured using gibberellic acid (GA3). Previous researches showed that growth regulators such as gibberellic acid had an effective role on the production potentiality of many flowers corps. Verma *et al*., (2000) found that spraying the carnation plants with GA_3 at different concentrations produced more flowers and improved flowering stem characteristics. In addition, the effective role of GA_3 application on the growth and flowering was assured with tuberose (El-Naggar and Sharaf, 2002).

Due to the excessive use of chemical fertilizers in intensive agriculture systems to meet the demands of the overpopulated civilizations, environmental stress and potential pollution of natural resources are caused (El-Sherpiny *et al*., 2022 and El-Sherpiny *et al*., 2022). As a result, alternative farming methods such employing microorganisms as bio-fertilizers in agriculture are considered as a way to preserve the environment and stop pollution (Ramadan *et al*., 2002). In addition chemical fertilizers being costly, and may reduce the stability of soil organic matter and microbial activity.

Biological fertilizers offer an environmentally responsible and more sustainable method of boosting crop output than agricultural chemicals. Many scholars have recently focused on this strategy. Recent studies showed that applying bio-fertilizers to soils can boost crop output, encourage nutrient availability and plant uptake, reduce inputs of chemical fertilizers, and lessen environmental concerns (Barsoom, 1998).

By enhancing the delivery of nutrients to the host plants, bio-fertilizers enhance plant growth at all stages. It is a substance that contains microorganisms that is used on plants, on seeds, or in the soil to influence and promote plant growth (Vessey, 2003). The ability of bio-fertilizers to boost plant growth while remaining economical and environmentally responsible, as well as the fact that their continued use has resulted in improved soil properties and knowledge of many microorganisms that promote plant growth. To better understand rhizospheric biology, bio-fertilizers have also been utilised extensively in contemporary agriculture (Mahdi *et al*., 2010).

Many researcher pointed out to the importance of bio-fertilizer in increasing growth, flowering and chemical

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DOI: 10.21608/jpp.2022.159702.1164

composition of some economic plants. Wahba (2002) revealed that foliar application of yeast at 2.5, 5.0 or 7.5 g/l on Oenothera biennis significantly increased plant height, additionally the fresh and dried leaf weights. The greatest concentration of yeast (7.5 g/l) gave the best result of flowering parameters, seed yield and vegetative growth. According to a study by Dubey *et al*. (2010), Sylvia was significantly worse than the other two gladiolus varieties for early flowering (116.16 days), florets/spike (13.60), higher floret diameter (8.37 cm), floret remaining open (5.86), and days to last floret opening (128.05 days), while Sylvia was significantly better for more days to last floret opening (135.04 days). Sharma and Khare (2014) revealed that the application of biofertilizer had significant effect on the all floral characteristics under study.

Thereupon, this investigation will study the effect of gibberellic acid (GA_3) and inoculation with the biofertilizers [Nitrobine+Phosphorein (NP)] on growth parameters, flowering, corm productivity and chemical composition of gladiolus bulbs.

MATERIALS AND METHODS

The present work was carried out during two successive seasons (2019/2020 and 2020/2021) at the west of Alexandria City, Egypt. Corms of Gladiolus gandavensis L. cv. " Rosesupreme " 8 – 10 cm in circumference, were planted on the 15th Nov, in each experimental seasons, using 20× 50 cm. Inter and intra row spacing and depth of 7 cm (Al-Humaid, 2001 and El-Naggar 2005) . At beginning of the experiment soil sample was analyzed according to Buurman *et al*. (1996).Avilable nutrient values were 75,16 and 273 ppm of N, P and K, respectively. The electrical conductivity (EC) and pH was 2.31 dS m^{-1} , 8.10 respectively .

I-Treatments and Expermimental layout:

The corms were soaked before planting for 24 hr with gibberellic acid (GA_3) at concentration of 0.00, 50, 100 and 200 mgl^{-1}. The biofertilizer used were nitrobein which contained nitrogen fixing-bacteria (Azotobacter and Azospirillum) and phosphorein (biofertilizer contains a specific clone of bacteria that converts the unavailable triphosphate to available monophosphate) mixed with the surface layer of the soil as following: NP_0 (without biofertilizer), 1 g (NP_1), 2g (NP_2), 3g (NP_3) for each one of nitrobein and phosphorein per plant. It was added twice, the first one with planting and the second one after 45 days (Samira and El-Tayeb, 2008). Biofertilizers (Nitrobine + Phosphorein) were obtained from the bio-fertilizer production unit of Agriculture research center, Giza, Egypt. All the plants under experiment received 5 g/ plant at one month intervals of a complete mineral fertilizer 19:19:19: (N: P_2O_5: K_2O) as dressing application. The fertilization started after one month from the planting date of corms. Mg was added as $MgSO_4.7H_2O$ (9.5 % Mg) and Fe in form of Fe-EDTA (14 % Fe) were sprayed three times after 45 days and two weeks intervals until the run–off threshold was reached at 150 and 75 ppm for Mg and Fe, respectively.

II - Experimental design:

The experimental sixteen treatments was lay-out in randomized complete blocks design in factorial type with three replicates as following: 4 concentration of gibberellic acid (GA_3) and 4 levels of biofertilizers (Nitrobine+Phosphorein), with ten plants/plot for each treatment.

III - Data measurements and recorded: The following morphological measures were taken on the grown gladiolus plants at the end of each growing season:

1- Characteristics of vegetative growth: plant height (cm), leaves number/plant and fresh weight of leaves / spike (g).
2- Flowering characteristics: the numbers of days from corms planting to flowering (day), number of florets /spike, and dry weights of spike L plant (g).
3- New corms yield parameters : corms volume (cm^3) and corm dry weight (g)

IV - Chemical constituents:

1- Photosynthetic pigments: During showing color stage of each growing season, total chlorophylls content (fresh leaves) was calorimetrically determined using the technique described by Inskeep and Bloom (1985) and calculated as mg/g fresh weight.
2- Total carbohydrate: The total carbohydrate contents (%) in dried the new corms samples were determined by according to Herbert *et al*., (1971).

V - Statistical analysis:

The collected data were tests in complete randomized block design using the computer programme of the statistical analysis programme (MSTAT-C) at the least significant differences (LSD) at 5% according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

I-The effect of gibberellic acid (GA_3), bio-fertilizers (NP) and their combination on vegetative growth characteristics of Gladiolus gandavensis L. cv. " Rosesupreme "plants:

The data presented in Table (1) show the effect of gibberellic acid (GA_3), bio- fertilizer and all possible combination between them on the different vegetative growth characteristics ; plant height , number of leaves/ plant and leaves fresh weight / spike of Gladiolus gandavensis L. cv. " Rosesupreme "plants.

Data in (Table 1) show that there was a significant effect during the two growing seasons on plant height (Fig. 1) leaves number / plant and leaves fresh weight / spike because of supplying the plants by gibberellic acid (GA_3). The best results were obtained by using 200 mgl^{-1}. Additionally, there was a significant impact of bio-fertilizer on vegetative growth of gladiolus during both seasons and the highest value was obtained by the plants inoculated with nitrobine+phosphorein (NP) at 6.0 g/plant. Concerning the interaction, application between the different concentrations of gibberellic acid (GA_3) and bio-fertilizers (nitrobine+phosphorein) treatments on promoted vegetative growth characteristics, the results recorded a significant increases in the values for the different growth parameters compared to the untreated plants. The highest values were observed with the application of GA_3 at 200 ppm in presence of bio- fertilizer level at 6.0 g / plant for several growth characteristics, such as plant height, leaves number / plant and leaves fresh weight / spike giving values of 129.48 cm, 15.15 and 38. 35 g, respectively in the first season, and 131.92cm, 15.74 and 39.99 g , respectively, in the second season for the above mentioned parameters. These results could be explained through the synergistic effect of GA_3 and bio- fertilizer nitrobine+phosphorein (NP) at their suitable and adequate combinations in promoting the vegetative growth and dry matter accumulation. Additionally, the activating of apical meristems alongside the protoplasm production, division, and elongation of

meristem cells may be the cause of the stimulating actions of both combined between GA3 and nitrobine+phosphorein, boosting the manufacture of proteins and carbohydrates and these improved growth. Similar results were obtained by Verma *et al*., (2000) on carnation plants Yadav *et al*., (2005) on tuberose EL-Naggar (2010) on Narcissus; Abbasniayzare *et al*., (2012) with *Spathiphyllum* EL- Naggar *et al*., (2016) on Anthurium.

Table 1. Means of plant height, number of leaves/ plant and leaves fresh weight /spike of Gladiolus gandavensis L. cv. '' Rosesupreme ''plants as affected by gibberellic acid(GA_3)and bio- fertilizers and their combinations in the two seasons.

Plant height (cm)										
	(1st) season					(2nd) season				
GA_3	Bio-fertilizer (NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	85.16	88.36	94.66	96.87	91.26	85.88	88.94	95.36	98.00	92.05
50.00	94.13	98.10	103.66	103.75	99.91	95.50	99.61	105.19	109.50	102.45
100.00	98.79	101.26	108.73	112.90	105.42	99.75	102.78	109.00	115.18	106.68
200.00	104.89	109.86	117.16	129.48	115.38	106.23	107.90	118.14	131.92	116.05
mean	95.74	99.40	106,05	110.75		96.84	99.81	106.92	113.65	
$LSD_{0.05}$		NP =2.33	GA_3=1.61	Inter. = 3.22			NP =2.12	GA_3=1.58	Inter.= 3.29	
Number of leaves/ plant										
GA_3	Bio-fertilizer (NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	7.29	8.82	10.23	11.13	9.37	7.52	9.14	10.13	11.39	9.51
50.00	9.23	11.73	12.10	12.66	11.44	9.22	11.13	12.35	12.67	11.34
100.00	11.06	12.98	13.67	14.99	13.18	11.93	13.19	13.90	14.87	13.47
200.00	11.75	13.79	14.74.	15.15	13.88	12.73	13.18	14.81	15.74	14.11
mean	9.83	11.83	12.41	13.48		10.35	11.66	12.80	13.67	
$LSD_{0.05}$		NP = 0.98	GA_3=1.06	Inter.= 1.37			NP =1.03	GA_3=1.26	Inter.=2.39	
Leaves fresh weight (g)/ spike										
GA_3	Bio-fertilizer (NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	21.23	23.14	23.98	24.18	23.13	22.08	23.29	23.94	25.20	23.63
500.00	24.19	25.00	27.74	28.99	26.48	23.33	24.18	25.76	28.91	25.55
100.00	26.18	26.09	29.51	31.56	28.33	24.00	26.17	29.73	32.83	28.19
200.00	26.77	28.23	34.87	38. 35	32.06	26.55	29.13	34.91	39.99	32.65
mean	24.59	25.62	29.03	30.77		23.99	25.69	28.59	31.73	
$LSD_{0.05}$		NP=1.09	GA_3=1.41	Inter.=1.75			NP =1.08	A_3=1.19	Inter.=2.23	

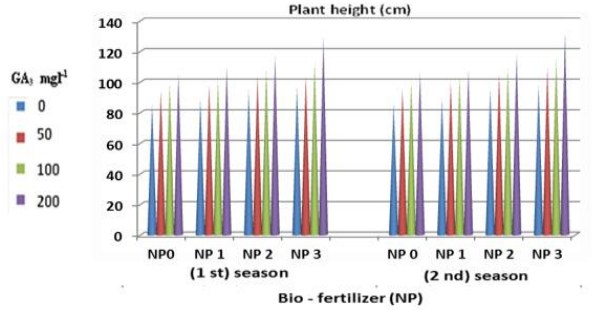

Fig. 1. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on plant height of Gladiolus gandavensis L. cv. '' Rosesupreme ''plants in the two seasons.

II-The effect of gibberellic acid (GA_3), bio-fertilizers (NP) and their combination on flowering of Gladiolus gandavensis L. cv. '' Rosesupreme '' plants:

The obtained results revealed that the mean of flowering time, number of florest / spike and dry weight were markedly improved as a result of addiing Gladiolus gandavensis L. cv. " Rosesupreme "plants with either gibberellic acid (GA_3) and/or biofertilizer Nitrobine+ Phosphorein (NP), compared to the untreated plants .

From observed data in table (2) it was found that the time taken to showing color in the two growing seasons were significantly decreased with the application of GA_3 alone or in combination with bio- fertilizers. The earliest reduction was obtained by using the highest doses of 200 mgl^{-1} GA_3 in combination with 6.00 g biofertilizer of nitrobine+phosphorein (NP) in the period from planting date until appearance of color, led to give the shortest period on the number of days to showing color (Fig. 2) 91.78 and 90.85 days as compared with the control 118.94 and 117.65 days in the first and second seasons. This may be due to that using gibberellic acid (GA_3) at suitable concentration with adding bio-fertilizer at the optimum level led to the increase and activation the formed roots. This stimulates absorption of the essential elements for flowers initiation and development. The same trend was reported by El-Naggar and sharaf (2002) on tuberose and Hassan *et al*., (2016) with gladioli plants.

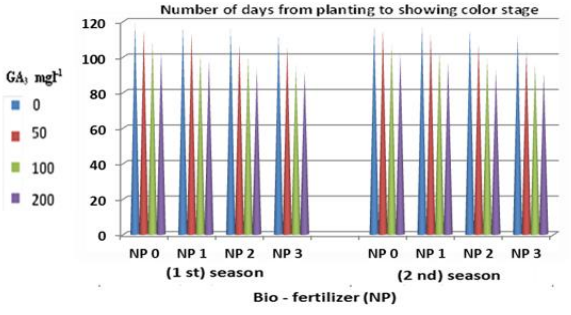

Fig. 2. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on number of days from planting to showing color stage of Gladiolus gandavensis L. cv. '' Rosesupreme ''plants in the two seasons.

The increment in the number of florets and spike dry weight as a result of using suitable GA_3 concentration with bio-fertilizer at optimum doses. The highest values of florets / spike (Fig. 3) and dry weight were obtained by GA_3 at concentration of 200 mgl^{-1} and 6.0 g bio- fertilizer as comparing to the other treatments during both seasons. The values scored (14.78 and 15.73) and (7.94 and 8.15) flower / plant for the control treatment in the 1st and 2nd seasons, respectively. While, these treatment

increased dry weight (5.82 and 5.85 cm) and (2.34 and 2.35 cm) resulted for the control treatment in the 1st and 2nd seasons, respectively (Table 2). This may be due to the role of gibberellic acid (GA_3) and/or the bio- fertilizer as nitrobine+phosphorein (NP), which is necessary for the synthesis of protein and cytokinin; consequently, affects cell division. These results are similar to those obtained by Ramesh *et al*., (2002) on carnation, El-Deeb (2016) on gladiolus, Imhmd *et al*., (2018) on chrysanthemum and El-Naggar *et al*., (2020) on chamomile plants.

Table 2. Means of number of days from planting to showing color stage, number of florets /plant and spike dry weight (g) of Gladiolus gandavensis L. cv. '' Rosesupreme '' plants as affected by gibberellic acid (GA_3) and bio-fertilizers and their combinations in the two seasons.

	Number of days from planting to showing color stage (1st) season					(2nd) season				
GA_3	Bio-fertilizer (NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	118.94	117.22	115.61	112.80	116.14	117.65	117.35	115.65	111.77	115.61
50.00	115.24	113.66	107.26	105.58	110.44	115.39	112.81	107.22	103.14	109.64
100.00	108.98	101.82	100.46	94.93	101.55	107.11	102.79	99.45	95.87	101.31
200.00	102.66	97.81	92.87	91.78	96.28	101.78	96.90	92.85	90.58	95.58
mean	111.46	112.63	104.05	101.27		110.48	107.46	103.80	100.34	
$LSD_{0.05}$	NP = 1.50		GA_3= 1.62	Inter.= 1.93		NP =1.47		GA_3=1.63	Inter.=1.86	
	Number of florets/spike									
GA_3	Bio-fertilizer (NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	7.94	8.22	8.61	9.50	8.57	8.15	8.75	9.45	9.59	8.99
50.00	9.24	9.96	11.26	12.58	10.76	9.39	9.99	11.22	12.84	10.86
100.00	10.08	10.82	12.46	12.93	11.57	10.11	10.85	12.85	13.87	11.99
200.00	12.00	12.21	13.87	14.78	13.22	11.78	11.97	13.90	15.73	13.35
mean	9.82	10.30	11.55	12.45		9.11	1039	11.86	13.01	
$LSD_{0.05}$	NP = 0.42		GA_3= 0.63	Inter.= 0.92		NP = 0.45		GA_3=0.69	Inter.=0.91	
	Spike dry weight (g)									
GA_3	Bio-fertilizer (NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	2.34	2.81	3.25	3.67	3.02	2.35	2.83	3. 59	3.71	2.97
50.00	3.47	3.84	4.60	4.85	4.19	3.50	3.80	4.62	4.87	4.20
100.00	3.99	4.90	5.35	5.39	4.91	3.97	4.92	5.36	5.60	4.96
200.00	5.08	5.12	s5.59	5.82	5.40	5.14	5.29	5.55	5.85	5.46
mean	3.74	4.17	4.70	4.93		3.74	4.21	4.78	5.03	
$LSD_{0.05}$	NP =1.13		GA_3=1.32	Inter.=1.65		NP =1.10		GA_3=0.90	Inter.=1.60	

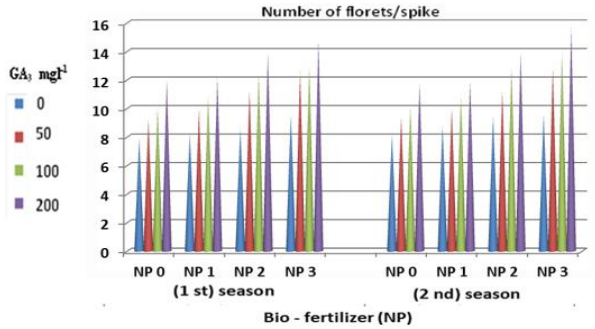

Fig. 3. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on Number of florets/spike of Gladiolus gandavensis L. cv. "Rosesupreme" plants in the two seasons.

III- Effect of gibberellic acid (GA_3), bio-fertilizers(NP) and their combination on corms production of Gladiolus gandavensis L. cv. '' Rosesupreme ''plants:

Data in Table (3) show significant increases in new corms production as a result of treating to GA_3compared to the control plants. The highest values were observed with the addition of GA_3 at 200 mgl^{-1} for corms characteristics, such as corms volume (cm^3) (Fig. 4) and corm dry weight (g) (Fig. 5) giving values of 10.15 cm^3 and 2.13 g respectively in the first season, and 10.85 cm^3 and 2.19 g , respectively, in the 2nd season for aforementioned parameters. Regarding the bio- fertilizing rates (nitrobine+phosphorein), they significantly increased corms volume (cm^3) and corm dry weight (g) compared to the control. The high level of bio- fertilizer (6.0 g) gave the highest values of corms volume (cm^3) and corm dry weight (g) compared to the other treatments in the two seasons. The interaction between gibberellic acid (GA_3) and bio-fertilizers (NP) treatment significantly affected corms volume (cm^3) and corm dry weight (g). Whereas, the highest results was obtained by using GA_3at 200 mgl^{-1} combined with 6.0g nitrobine+phosphorein (NP) comparing to the other treatment during both growing seasons. The maximum values in this respect as they reached the corms volume to 13.28 and 14.59 cm^3 and corm dry weight to 2.59 and 2.61 g in both seasons, respectively. While, the lowest values of corms volume (cm^3) and corm dry weight (g) recorded with control treatment in both seasons. These results may be attributed to that GA_3 witsing in cell division, cell elongation, enzyme activation and translocation and accumulation of the assimilated compounds such as carbohydrates, sucrose, glucose and fructose in the storage plant parts which promote the initiation and development of new corms. These results are in agreement with those reported by EL-Naggar and Sharaf (2002) on tuberose and Dalve *et al*., (2009) on gladiolus and El-Deeb, (2016) on gladiolus.

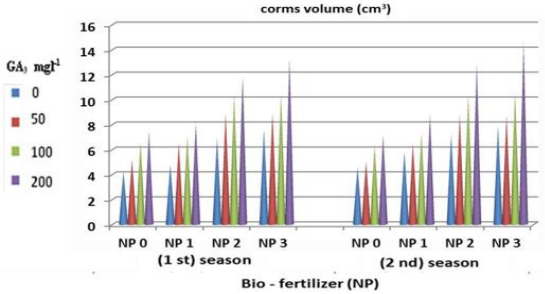

Fig. 4. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on corms volume (cm^3) of Gladiolus gandavensis L. cv. "Rosesupreme" plants in the two seasons.

Table 3. Means of corms volume (cm^3) and corm dry weight of Gladiolus gandavensis L. cv. '' Rosesupreme '' plants as affected by gibberellic acid (GA_3) and bio- fertilizers and their combinations in the two seasons.

Corms volume (cm^3)										
	(1st) season					(2nd) season				
GA_3	Bio-fertilizer(NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	4.24	4.76	6.90	7.57	5.85	4.59	5.81	7.19	7.86	6.36
50.00	5.18	6.47	8.85	8.93	7.38	5.01	6.49	8.75	8.69	7.24
100.00	6.56	7.10	10.35	10.41	8.61	6.32	7.27	10.39	10.56	8.64
200.00	7.41	8.11	11.81	13.28	10.15	7.13	8.82	12.87	14.59	10.85
mean	5.85	6.61	9.48	10.02		5.76	7.10	9.93	10.45	
$LSD_{0.05}$		NP =0.52	GA_3=0.64	Inter.=1.11			NP =0.22	GA_3=0.70	Inter.=1.95	
	Corm dry weight(g)									
GA_3	Bio-fertilizer(NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	0.83	0.89	1.02	1.07	0.95	0.92	0.97	1.04	1.09	1.01
50.00	0.88	1.10	1.36	1.42	1.19	0.83	1.22	1.37	1.56	1.23
100.00	1.29	1.98	2.23	2.47	2.04	1.27	2.01	2.29	2.49	2.02
200.00	1.51	2.06	2.34	2.59	2.13	1.53	2.25	2.37	2.61	2.19
mean	1.13	1.51	1.78	1.89		1.14	1.61	1.77	1.94	
$LSD_{0.05}$		NP = 0.13	GA_3= 0.07	Inter.=0.19			NP = 0.15	GA_3= 0.08	Inter.=0.19	

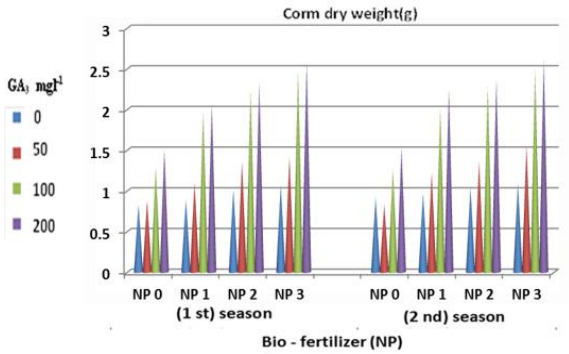

Fig. 5. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on corm dry weight of Gladiolus gandavensis L. cv. ''Rosesupreme'' plants in the two seasons.

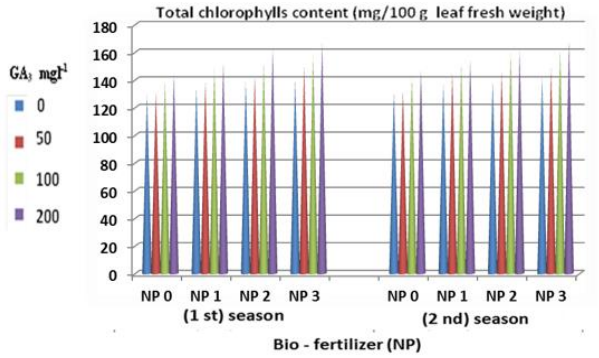

Fig. 6. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on total chlorophylls content (mg/100 g L. F. W.) of Gladiolus gandavensis L. cv. ''Rosesupreme'' plants in the two seasons.

IV - Effect of gibberellic acid (GA_3), bio-fertilizers (NP) and their combination on chemical constituents of Gladiolus gandavensis L. cv. '' Rosesupreme ''plants

1- Total chlorophyll (a+b) in leaves (mg/100 g F.W.):

It is shown from the data presented in Table (4), the effect of gibberellic acid (GA_3) application of with nitrobine+ phosphorein (NP) as bio-fertilization on total chlorophyll (a+b) content in mg/100 g. the lowest mean values of chlorophyll contents realized with the untreated plants, which receiving any concentrations of GA_3 alone or combined with potassium fertilizer. While, the highest significant increases in the total chlorophyll contents (Fig. 6) were obtained from plants treated with GA_3 at either 100 or 200 mgl^{-1} in the presence of bio - fertilizer at a level of 6.0 g / plant, as compared with the control. These results may be attributed to the enhancing effect of GA_3 with nitrobine+phosphorein (NP) at suitable concentrations on the absorption of the essential elements specially nitrogen (NH_4), phosphorus (P), iron (Fe^{++}), magnesium (Mg^{++}) cations, which are found in many metabolically active compounds, including chlorophylls and these elements are necessary for enzymes activation and formation of chloroplasts and chlorophyll (Hassouna and Madkour, 1991) Besides, using GA_3 and bio – fertilizer encourage the production of chlorophyll in leaves, by increasing the amount of green pigments in plants. This result was confirmed by Sherif and El-Naggar (2005) on Calla lily and Moghith (2016) on Origanum

2- Total carbohydrates (%) in new corms:

The results of the chemical analysis indicated that the total carbohydrate percentages in the new corms of *Gladiolus gandavensis* L. cv. " Rosesupreme "plants were significantly increased with GA_3 and bio- fertilizer application compared with untreated. The highest significant increase in the total carbohydrates (%) (Fig. 7) was observed from GA_3 at 200 ppm (58.51 and 57.42 %) in the 1st and 2nd seasons, respectively as compared to the other treatment (Table 4). While, the followed values were obtained by 100 mg l^{-1} (47.92 and 49.19 %) for both seasons, respectively. Regarding the bio- fertilizer treatments (NP) at 2.0, 4.0 and 6.0 g/plant, significantly affected in the total carbohydrates content. The highest value was realized with plants inoculated by the bio- fertilizer at 6.0 g compared to the control during two seasons. Concerning the interaction, the highest significant increase in the total carbohydrates (%) was obtained from interaction between 200 ppm GA_3 and 6.0 g bio-fertilizer. These treatment increased the total carbohydrates as (73.09 and 73.89 %) and (27.13 and 28.00 %) for the control in the 1st and 2nd seasons, respectively. This improvement in the total carbohydrate contents as a result of application with GA_3 in presence of bio- fertilizer could be attributed to physiological role of GA_3 with nitrobine+ phosphorein in enhancing leaf production , which probably had higher chlorophyll content and consequently more carbohydrates production, beside the mode of action of bio-fertilizer in the activation of enzymes

of carbohydrates transformation or in the regulation of the consumption sugars and the promotion of water and Co_2 absorption, which can be led to increase the capacity of plants in building metabolites, , consequently the amount of the stored carbohydrate in the new corms could be increased. These results agree with those reported Eraki *et al*., (1993) on rose, and El- Naggar (1999) on gladiolus plants, Hend *et al*., (2002) on antholyza and El-Deeb, (2016) on gladiolus

Table 4. Means of total chlorophylls content (mg/100 g L. F. W.) and total carbohydrates (%) in corms of Gladiolus gandavensis L. cv. '' Rosesupreme ''plants as affected by gibberellic acid (GA_3) and bio- fertilizers and their combinations in the two seasons.

Total chlorophylls content (mg/100 g leaf fresh weight)										
	(1st) season					(2nd) season				
GA_3	Bio-fertilizer(NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	129.62	134.73	138.94	140.86	136.08	131.55	137.21	139.10	142.06	137.48
50.00	131.67	138.76	142.88	149.98	140.80	132.01	145.01	146.65	148.89	143.14
100.00	139.57	148.56	152.32	158.31	149.69	142.63	151.22	159.39	161.97	153.80
200.00	143.91	152.11	162.51	167.20	156.43	147.27	154.62	161.80	168.54	158.06
mean	136.19	143,54	149.16	154.09		138.37	147.08	151.74	155.37	
$LSD_{0.05}$		NP =2.02	GA_3=2.44	Inter.=3.01		NP =2.02		GA_3=2.50	Inter.=2.98	
	Total carbohydrates (%)									
GA_3	Bio-fertilizer(NP)									
mgl^{-1}	NP_0	NP_1	NP_2	NP_3	mean	NP_0	NP_1	NP_2	NP_3	mean
00.00	27.13	28.93	34.72	38.02	32.20	28.00	29.98	34.67	40.45	33.28
50.00	29.74	35.82	37.92	42.16	36.41	30.83	38.32	40.27	47.92	39.34
100.00	29.03	45.92	52.92	63.82	47.92	32.01	44.92	53.82	66.02	49.19
200.00	36.28	56.73	67.86	73.09	58.50	37.92	52.18	64.12	73.89	57.42
mean	30.51	32.10	48.35	54,27		32.19	41.35	48.22	57.07	
$LSD_{0.05}$		NP = 1.13	GA_3= 1.17	Inter.=2.15		NP = 1.15		GA_3= 1.28	Inter.=2.19	

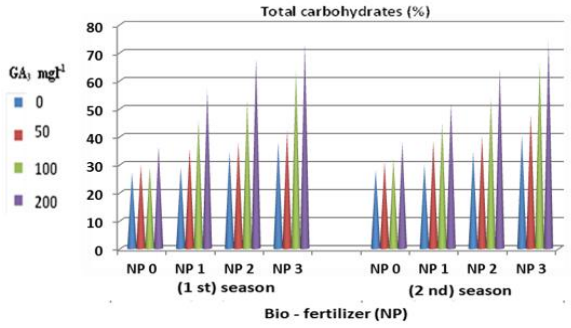

Fig. 7. Effect of gibberellic acid (GA_3) and bio- fertilizers and their combinations on total carbohydrates (%) of Gladiolus gandavensis L. cv. ''Rosesupreme'' plants in the two seasons.

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تأثير المعاملة بحامض الجبريللين والسماد الحيوي على نمو وجودة الإزهار لنباتات الجلاديولس

على حسن النجار[1] و مكة على حسن [2]

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الملخص

أجريت الدراسة لبحث تأثير حامض الجبريللين عند أربع تركيزات صفر، 50، 100 ، 200 ملليجرام/لتر بنقع كورمات الجلاديولس لمدة 24 ساعة و أربع تركيزات من التسميد الحيوي (النيتروبين + الفوسفورين 1:1) صفر، 2.0، 4.0، 6.0 جم/ نبات و التفاعل بينهم على على النمو الخضري والإزهار وإنتاج الكورمات لنبات الجلاديولس صنف " روزسبريمي" و أجريت جميع التوافيق الممكنة بين كل من تركيزات حامض الجبريللين و معاملات التسميد الحيويو أوضحت النتائج المتحصل عليها أن المعاملة بحامض الجبريللين أو بالسماد الحيوي بتركيزاته المختلفة بصورة فردية أو متداخلة مع حامض الجبريللين قد أدت إلى زيادة معنوية فى كل من قياسات النمو الخضرى و الزهرى وانتاج الكورمات مقارنة بنباتات معاملة المقارنة (الكنترول) و أوضحت نتائج التحليل الكيماوى تحسن في محتوى الأوراق الطازجة من الكلوروفيل (أ + ب) وكذلك النسبة المئوية لمحتوى الكورمات من الكربوهيدرات الكلية نتيجة للمعاملة بكل من حامض الجبريللين و السماد الحيوي مقارنة بنباتات معاملة الكنترول.و يمكن القول إجمالا بأن أفضل النتائج تم التوصل إليها بعد المعاملة بحامض الجبريللين بتركيز 200 ملليجرام لكل لتر في وجود السماد الحيوي عند التركيز4.0 أو 6.0 جم / نبات ، بينما أظهرت نباتات معاملة الكنترول أقل القياسات فى هذا الصدد.

الكلمات الدالة: جبرللين - تسميد حيوي -جلاديولس