RESPONSE OF *GLADIOLUS* SP. CVS. WHITE AND ROSE PROSPERITY PLANTS TO SOME FERTILIZATION TREATMENTS

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ABSTRACT

Two independent field experiments were carried out at the nursery of Hort. Res. Inst., ARC, Giza, Egypt during 2008 and 2009 seasons to study the effect of biogien (a commercial product which contains a specific strain of *Azotobacter chroococcum* bacteria, at conc. of 10^6 cells/ml) as a soil dressing at the rates of 0, 5, 10 and 15 g/plant, soaking the corms before planting in actosol solution (a humic acid NPK (10:10:10) liquid organic fertilizer) at the rate of 20 ml/L for 0, 12 and 24 hours and their interactions on growth, flowering and corms productivity of *Gladiolus* sp. cvs. White Prosperity (white florets) and Rose Prosperity (rose florets) plants. The corms were planted in beds of 1x1 m at a depth of 7 cm from soil surface and a distance of 20x20 cm from each other. Biogien was added 3 times before flowering with one month interval and one time only immediately after flowering.

The obtained results indicated that all vegetative growth parameters; expressed as: plant height (cm), number of leaves/plant and aerial parts fresh and dry weights (g), as well as flowering traits; expressed as : flowering stalk length and diameter (cm) and its fresh and dry weights (g), rachis length (cm), number of florets/flowering stalk and first floret diameter (cm) of both cultivars were progressively increased with either increasing biogien rate or elongating soaking period of humic acid solution with various significant differences in the two seasons. The opposite was the right concerning number of days from planting to first floret open character,

as all fertilization treatments used in the study caused a significant precocity in most cases of both seasons.

The superiority in all previous parameters was for the combined treatment between 15 g biogien/plant and soaking corms in humic acid solution for 24 hrs., as it gave the highest means in the two seasons. Similarly, new corm diameter (cm) and its fresh and dry weights (g), as well as number of cormels/plant in both cultivars were increased with either rising biogien level or prolonging soaking period, with the mastery of combined treatment mentioned above which gave the greatest No. and heaviest new corms and highest cormels No./plant.

So, it could be recommended to fertilize *Gladiolus* sp. cvs. White and Rose Prosperity plants cultivated in a clayey soil with biogien biofertilizer at 15 g/plant, three times before flowering at one month interval and only one time immediately after flowering with soaking the corms before planting in 20ml/l humic acid solution for 24 hrs. to get the best growth, flowering and corms productivity.

INTRODUCTION

Gladiolus L., corn flag or sword lily (Fam: Iridaceae) is one of the most important commercial cut flowers all over the world. The smaller flowered cultivars are used for the herbaceous border. It is a tender and perennial herb with tunicate corms. Native to Europe, Mediterranean region, the Near East, but chiefly to tropic and South Africa. Flowers are showy, sometimes fragrant, in 1-sided spikes. Propagated mainly by corms and cormels that form around the old corm (Bailey, 1976).

Fertilization is considered one of the main factors greatly affect growth, flowering and corm productivity of gladiolus. In this regard, Misra (1998) found that Nafed Super Culture (NSC), containing *Azotobacter* sp., micronutrients and vitamins, at 50 and 100 g/l of water significantly increased the number of florets/spike of gladiolus var. Melodie, while at 100 g/l of water significantly increased the number and weight of cormels/plant. Hanel and Muller (2006) observed that *Gladiolus imbricatus* grew well in moderately and strongly acidic, humic soil. On gladiolus cv. American Beauty, Srivastava *et al.,* (2007) reported that Azotobacter, phosphate solubilizing bacteria (PSB) and VA-mycorrhiza significantly improved different vegetative and floral characters as compared to control. Vegetative growth was enhanced most effectively by

Azotobacter treatment. However, for quality spike production, PSB was found more effective.

Similar observations were also obtained on tuberose by Haripriya and Poonkodi (2005), Yadav *et al.,* (2005), Kukde *et al.,* (2006) and Chaudhary (2007) who pointed out that application of Azotobacter, PSB and VAM in combination with N at 200 kg/ha and P at 100 kg/ha greatly increased plant height, No. leaves/plant, No. bulbs/plant and advanced the sprouting of bulbs.

On onion, Sangeetha *et al.,* (2008) mentioned that soil application of humic acid at 20 kg/ha with 100% of the recommended dose of NPK fertilizers (60:60:30 kg/ha) recorded the highest No. bulbs/plant, maximum bulb girth and bulb weight and yield. Besides, combined application of humic acid and recommended dose of inorganic fertilizers significantly improved the quality parameters, such as total soluble solids, ascorbic acid content, total sugars and pyruvic acid content as compared to other treatments. On the same line, were those results of Evans and Li (2003) on *Catharanthus roseus*, *Pelargonium hortorum*, *Tagetes patula* and *Viola tricolor*, El-Sayed *et al.,* (2008) on Tifway Bermudagrass and El-Sayed *et al*., (2009) on *Nephrolepis exaltata.*

MATERIALS AND METHODS

Two independent field experiments were conducted at the nursery of Hort. Res. Inst., ARC, Giza, Egypt during the two consecutive seasons of 2008 and 2009 to study the effect of biogien and humic acid, alone or in combinations on growth, flowering and corm production in two cultivars of gladiolus.

Corms of *Gladiolus* sp. cvs. White Prosperity and Rose Prosperity at the size ranged between 5-6 and 6-7 cm diameter for the first and second cultivars, respectively were imported from Holland, as they had already received the required cooling treatment. They were dipped before planting in a fungicide solution of 0.25% orthocide for 15 minutes, and then were planted on February, 1st at a depth of 7 cm from soil surface in beds of 1x1 m, as every bed contained 16 corms planted at a distance of 20x20 cm for both seasons. Soil samples were taken before planting for physical and chemical analysis as shown in Table (a).

Table (a): Some physical and chemical properties of the soil in the two seasons.

Season	Particle size distribution (%)				pH	E.C. (ds/m)	S.P.	Cations (meq/L)				Anions (meq/L)		
	Coarse sand	Fine sand	Silt	clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}
2008	7.54	22.78	30.55	39.63	8.05	2.21	55	7.82	2.12	15.4	0.75	6.60	8.20	11.29
2009	7.64	22.50	30.15	39.71	8.00	2.33	53	7.50	2.20	15.5	0.75	6.78	8.02	11.15

Fertilization treatments were applied in the present work as follows:

1- No fertilization, reffered to as control.

2-Biofertilization with biogien (a commercial product which contained a specific strain of *Azotobacter chroococcum* bacteria, at a conc. Of 10^6cells/ml) at the rates of 0, 5, 10 and 15 g/plant, added as a soil dressing, three times before flowering from mid of February with one month interval, while another batch was added immediately after flowering.

3- Soaking the corms before planting in actosol® solution (a humic acid NPK (10:10:10) liquid organic fertilizer) at the rate of 20 ml/l for 0, 12 and 24 hours. The constituents of actosol® were determined and illustrated in Table (b).

Table (b): Main characteristics of the used liquid active fertilizer (actosol®) during 2008 and 2009 seasons.

Components	Value	Components	Value	Components	Value
Humic acid (%)	2.9	EC(dS/m)	59.3	B (mg/l)	70.00
Organic matter/total solid (%)	42.51	N (%)	10.00	Fe (mg/l)	900.00
Total HA/total solid	165.80	P (%)	10.00	Mn (mg/l)	90.00
Organic carbon (%)	24.64	K (%)	10.00	Zn (mg/l)	90.00
C/N ratio	2.46	Ca (%)	0.06		
pH	8.10	Mg (%)	0.05		

4- Each level of biogien was combined with each period of soaking in actosol® solution to form twelve interaction treatments.

The layout of the experiment for each cultivar in the two seasons was a split-plot design (Mead *et al.,* 1993) with three replicates as

each bed contained 16 plants expressing one replicate. The main plot represented biogien treatments whereas sub plots were devoted for humic acid. Irrigation and agricultural practices were done whenever needed, as usually grower did.

During flowering phase, number of days from planting to first open (days), plant height (cm), number of leaves/plant, aerial parts fresh and dry weights (g), flowering stalk length (cm), number of florets/flowering stalk and first floret diameter were measured, while at the end of experiment (May, 30th) the following data were recorded on, new corm diameter (cm) ant its fresh and dry weight (g), as well as number of corms/plant.

Data were then tabulated and statistically analyzed according to SAS Program (1994) using Duncan's multiple range test (1955) to verify the significant differences among means of the various treatments.

RESULTS AND DISCUSSION

I. Effect of fertilization treatments on growth, flowering and corm productivity of cv. White Prosperity plants:

1. Vegetative growth:

It is obvious from data registered in Table (1) that all vegetative growth traits (plant height (cm), No. leaves/plant and aerial parts fresh and dry weights (g)) were progressively increased with increasing either the rate of biogien or soaking period in humic acid solution, but the means recorded by the medium and high levels of biogien (10 and 15 g/plant, respectively), as well as by the short and long periods of soaking in humic acid solution were closely near together with non-significant differences among themselves in most instances of both seasons. However, the superiority in all previous parameters was due to the combination between 15 g biogien/plant and soaking for 24 hrs. in humic acid solution, as such combination gave, in general the highest records in the two seasons. This may be attributed to the role of both biogien and humic acid in providing the plants with nutrients necessary for good and healthy growth. In this concern, Dorer and Peacock (1997) indicated that humic acid can provide soil microbs with energy, improve nutrients retention in the soil and enhance the waterholding capacity. Darwish (2002) mentioned that *Azotobacter chroococcum* fixes atmospheric N and secrets some growth promoting

Table (1): Effect of biogien, humic acid and their interactions on some vegetative growth parameters of *Gladiolus* sp. cv. White Prosperity plants during 2008 and 2009 seasons.

Humic acid soaking period (hours) / Biogien (g/plant)	Plant height (cm)				No. Leaves/plant				Aerial parts F.W. (g)				Aerial parts D.W. (g)			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	54.33c	59.00bc	59.67bc	57.67c	7.67e	7.93e	8.33de	7.98b	42.57e	52.10cd	58.30b	50.99c	10.67d	11.02d	12.00c	11.23b
5.0	61.67b	63.33ab	62.33b	62.44b	8.33de	8.76cd	9.00bc	8.70ab	47.91de	54.18c	62.10ab	54.73b	11.58cd	11.50cd	14.35ab	12.48ab
10.0	62.00b	64.00ab	66.10a	64.03ab	8.67cd	9.33b	9.67ab	9.22a	50.19d	58.22b	63.72a	57.38ab	12.79bc	13.31b	15.23a	13.78a
15.0	62.78ba	66.33a	67.00a	65.37a	9.00bc	9.82ab	10.33a	9.72a	54.03c	59.74b	65.33a	59.70a	12.98bc	13.56b	15.34a	13.96a
Mean	60.20b	63.17a	63.78a		8.42b	8.96a	9.33a		48.68b	56.06ab	62.36a		12.01b	12.35b	14.23a	
	Second season: 2009															
0.0	56.03d	58.95cd	61.39c	58.79c	8.00c	8.30cb	8.76bc	8.35b	44.38e	48.51de	56.50cb	49.80c	11.20d	11.56cd	12.58cb	11.78b
5.0	63.70bc	65.87b	66.10b	65.22b	8.56bc	8.91b	9.45ab	8.97ab	46.97e	55.68c	63.17ab	55.27b	12.08c	12.10c	15.00ba	13.06b
10.0	64.76bc	66.59b	68.36a	66.57ab	8.97b	9.68ab	10.20a	9.62a	51.56d	60.33b	65.21a	59.03ab	13.45bc	14.00b	15.77a	14.41a
15.0	65.33b	69.90a	70.31a	68.51a	9.45ab	10.23a	10.82a	10.17a	55.20c	62.71ab	68.47a	62.13	13.55b	14.76b	16.21a	14.84a
Mean	62.46b	65.33a	66.54a		8.75b	9.28ab	9.81a		49.53b	56.81ab	63.34a		12.57b	13.11b	14.89a	

- Means within a column or row having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

factors, e.g. gibberellin, cytokinin-like substances, auxins, as well as some vitamins such as thiamine, riboflavin, pyridoxine, cyanocobolamine, nicotinic and pantothenic acids. Furthermore, Subba Rao (1993) reported that *Azotobacter chroococcum* synthesize antifungal antibiotics, which gave it additional advantage for the use in the field of bioproduction.

These results, are however in accordance with those attained by Misra (1998) on gladiolus var. Melodie, Hanel and Muller (2006) on *Gladiolus imbricantus* and Chaudhary (2007) on tuberose.

2. Flowering:

Data in Table (2) clear that all fertilization treatments used in this trial caused a significant precocity in flowering of treated plants. However, the minimum number of days from planting to first floret open was recorded from the combined treatment between the highest rate of biogien (15g/plant) and the longest period of soaking in humic acid solution (24 hrs.), which reduced No. days to flowering to 88.10 and 88.21 days in the first and second seasons, respectively. Accelerating rate of growth by such combination, may be the direct reason for the significant earliness in flowering by about 6-7 days comparing with control in both seasons, and may indicate the synergistic effect of both biogien and humic acid on promoting cell division and increasing flower primordia differentiation within the flower bud.

A similar trend was also obtained regarding flowering stalk length (cm), diameter (cm) and fresh and dry weights (g), as this combined treatment gave the longest, thickest and heaviest flowering stalk at all.

Rachis length (cm), number of florets/flowering stalk and first floret diameter (cm) were also increased with elevating either biogien level or soaking period, with the prevalence of the combined treatment of 15 g biogien/plant + 24 hrs. soaking in humic acid, which scored the utmost high means in all previously mentioned characters in the two seasons when compared to control and all other treatments.

In general, the effect of soaking in humic acid solution on flowering was more pronounced than that of biogien treatments, especially soaking treatment for 24 hrs., which gave always a significant increment in most flowering measurments compared with the short period (12 hrs.) and non-soaking ones, but rising the rate of

Table (2): Effect of biogien, humic acid and their interactions on flowering of *Gladiolus* sp. cv. White Prosperity plants during 2008 and 2009 seasons.

Humic acid soaking periods (hours) / Biogien (g/plant)	No. days from planting to flowering				Flowering stalk length (cm)				Flowering stalk diameter (cm)				Flowering stalk F.W. (g)			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	94.88a	93.68a	92.16b	93.57a	89.33c	93.77c	99.40b	94.17c	0.57b	0.60b	0.81b	0.66c	44.01d	48.36c	57.00ab	49.79b
5.0	92.33b	91.50bc	90.50c	91.44a	96.00cb	98.23b	105.30ab	99.84b	0.60b	0.83b	0.92ab	0.78b	45.90dc	49.10c	57.18ab	50.73b
10.0	90.76c	89.85dc	89.00d	89.87b	98.76b	103.64ba	106.76a	103.05a	0.83b	0.93ab	0.96a	0.91a	47.06cd	51.50bc	58.76ab	52.44ab
15.0	90.33cd	89.00d	88.10d	89.14b	101.70b	104.00ab	108.33a	104.68a	0.86ba	0.93ab	0.98a	0.92a	49.43c	54.85b	62.48a	55.59a
Mean	92.08a	91.01a	89.94b		96.45c	99.91b	104.95a		0.72b	0.82	0.92a		46.60c	50.95b	58.86a	
	Second season: 2009															
0.0	95.00a	94.05a	92.86b	93.97a	92.41d	96.72c	103.00b	97.38d	0.59c	0.63c	0.83b	0.68b	45.76d	48.89cd	56.41b	50.35b
5.0	92.50b	91.58bc	90.67c	91.58ab	96.70c	101.00b	109.20a	102.30c	0.62c	0.86b	0.91ab	0.80ab	47.60d	50.96c	58.50ab	52.35b
10.0	90.93c	90.03cd	89.13d	90.03b	99.92bc	106.00ab	110.98a	105.63b	0.81b	0.90ab	0.97a	0.89a	49.33cd	56.56bc	60.74a	54.54a
15.0	90.10cd	89.20d	88.21d	89.17b	102.00b	110.23a	112.63a	108.29a	0.85b	0.93a	0.98a	0.92a	51.00c	56.17b	63.20a	56.79a
Mean	92.13a	91.22a	90.22b		97.76c	103.49b	108.95		0.72b	0.83a	0.92a		48.42c	52.40b	59.71a	
Humic acid soaking periods (hours) / Biogien (g/plant)	Flowering stalk D.W. (g)				Rachis length (cm)				No. of florets per flowering stalk				First floret diameter (cm)			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	5.61c	6.29b	6.97b	6.29b	49.00d	55.00c	60.33b	54.78c	5.00d	6.00c	8.00b	6.33c	7.33c	8.50b	8.67b	8.17b
5.0	6.03bc	6.47b	7.53ab	6.68ab	53.00cd	56.78cb	62.67ab	57.48b	6.00c	7.67bc	8.33b	7.33b	7.91bc	9.50ab	9.83ª	9.08ª
10.0	6.17bc	6.66b	7.91ab	6.91ab	55.00c	59.33b	63.71a	59.35a	6.67c	7.89bc	9.76ab	8.11ab	8.83b	9.67ab	10.00a	9.50a
15.0	6.33b	6.83b	9.20a	7.45a	55.33c	61.48ba	65.80a	60.87a	7.33cb	8.33b	11.00a	8.89a	8.83b	9.83a	10.33a	9.66a
Mean	6.04b	6.56b	7.90a		53.08c	58.15b	63.13a		6.25c	7.47b	9.27a		8.23b	9.38a	9.71a	
	Second season: 2009															
0.0	5.82c	6.51cb	7.11b	6.48b	50.38d	56.10c	61.00b	55.83c	5.00d	6.33c	8.32b	6.55c	7.00c	8.21b	8.38b	7.86b
5.0	6.24cb	6.50cb	7.80b	6.85b	55.00cd	58.96bc	63.28ab	59.08b	6.00c	8.00b	8.76b	7.59b	7.73bc	8.86b	9.90a	8.83ab
10.0	6.43	6.93b	8.22ab	7.19ab	57.32c	61.33b	65.50a	61.38a	6.86cb	8.00b	10.00a	8.29ab	8.26b	9.50a	10.26a	9.34a
15.0	6.70bc	7.20b	9.36a	7.75a	58.61bc	63.00ab	67.85a	63.15a	7.48bc	8.71b	11.33a	9.17a	8.80b	9.67a	10.50a	9.66a
Mean	6.30b	6.79b	8.12a		55.33c	59.85b	64.41a		6.34c	7.76b	9.60a		7.95b	9.06a	9.76a	

- Means within a column or row having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

biogien from 10 to 15 g/plant caused a non-significant increment in most cases of both seasons.

Improvement the quality of flowering due to either biogien or humic acid, especially in combinations is reasonable, as they provide the plants with macro-and micro-nutrients necessary for best growth and high quality. These gains, are however similar to those of Srivastava *et al.,* (2007) on gladiolus cv. American Beauty and Sangeetha *et al.,* (2008) on onion.

3. Corms productivity:

From data averaged in Table (3), it could be concluded that new corm diameter (cm) and its fresh and dry weights (g) were cumulatively increased with either raising biogien rate or prolonging period of soaking in humic acid solution to reach maximum values with the highest level of biogien (15 g/plant) and the longest period of soaking (24 hrs.) in the two seasons. However, combining these two treatments together resulted the highest increment in diameter and weight of new corm. This may explain the role of both biogien and humic acid on promoting the synthesis of more reserve foods stored in the new corms and make them relatively greater and heavier.

A significant increment was also observed in the mean number of cormels/plant in both seasons as a result of applying biogien or soaking in humic acid solution, with the mastery of combined treatment between 15g biogien/plant plus soaking for 24 hrs. in humic acid solution, which gave 32.5 and 30.36 cormels/plant in the first and second seasons, respectively. This may be due to lump the benefit effects of both biogien and humic acid on supplying the growing buds with the required nutrients for accelerating growth, and hence forming more cormels.

Such results are in confirmity with those revealed by Misra (1998) on gladiolus var. Melodie, Yadav *et al.,* (2005) on tuberose and El-Sayed *et al.,* (2009) on *Nephrolepis exaltata.*

Table (3): Effect of biogien, humic acid and their interactions on corm productivity of *Gladiolus* sp. cv. White Prosperity plants during 2008 and 2009 seasons.

Humic acid soaking period (hours) / Biogien (g/plant)	New corm diameter (cm)				New corm F.W. (g)				New corm D.W. (g)				No. cormels/plant			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	2.53e	2.67ed	3.43bc	2.88b	7.46e	9.00d	11.37c	9.28c	3.11e	4.69cd	6.74b	4.85b	17.33d	18.46cd	20.67c	18.82b
5.0	2.63ed	3.11cd	3.80b	3.18ab	8.63de	11.96c	15.20b	11.93bc	3.86de	5.33c	7.78ab	5.66ab	18.33cd	21.00c	25.00b	21.44b
10.0	3.00d	3.26c	4.10a	3.45a	9.66cd	11.58c	18.56ab	13.27b	4.03d	5.36c	8.56a	5.98a	22.00cb	25.33b	30.67a	26.00a
15.0	3.27c	3.80b	4.20a	3.76a	11.51c	13.57bc	21.17a	15.42a	4.10d	5.98bc	8.73a	6.27a	23.67bc	25.00b	32.50a	27.06a
Mean	2.86b	3.21ab	3.88a		9.32c	11.53b	16.58a		3.78c	5.34b	7.95a		20.33b	22.45b	27.21a	
	Second season: 2009															
0.0	2.78d	2.94d	3.75bc	3.16b	8.21f	9.87e	12.40cd	10.16d	3.36e	5.28cd	6.93b	5.19b	18.70d	19.25d	21.00c	19.65b
5.0	2.90d	3.41c	4.18b	3.50ab	9.43e	11.89d	16.33b	12.55c	4.10de	5.72c	7.38b	5.73ab	19.67d	21.68c	23.86bc	21.74b
10.0	3.29cd	3.60c	4.60a	3.83a	10.56de	13.10c	19.80ab	14.49b	4.41d	5.98c	8.49a	6.29a	21.33c	24.56b	28.17a	24.69a
15.0	3.61c	4.16b	4.67a	4.15a	12.61cd	14.29c	22.11a	16.34a	4.56d	6.50bc	8.97a	6.68a	23.00bc	26.33b	30.36a	26.56a
Mean	3.15b	3.53ab	4.30a		10.20c	12.29b	17.66a		4.11c	5.87b	7.94a		20.68b	22.96ab	25.85a	

- Means within a column or row having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

II. Effect of fertilization treatments on growth, flowering and corm productivity of cv. Rose Prosperity plants:

1. Vegetative growth:

As noticed before in case of cv. White Prosperity plants, data in Table (4) exhibited that plant height (cm), No. leaves/plant and aerial parts fresh and dry weights (g) were significantly improved as a result of either dressing with biogien at the various rates or soaking corms in humic acid solution for the different periods, with the exception of No. leaves/plant trait, which was slightly improved in response to humic acid treatments with non-significant differences when compared to control in the two seasons. However, the combination of 15 g biogien/plant + soaking for 24 hrs. in humic acid solution was in a superior rank comparing with other treatments, as it gave the highest records in both seasons. This may indicate the synergistic effect of both biogien and humic acid on enhancing vital processes in plant tissues which reflects on vegetative growth.

These results may be discussed as those attained in case of vegetative growth of cv. White Prosperity plants as previously mentioned.

2- Flowering:

A similar trend to those results of flowering of cv. White Prosperity plants was also obtained for flowering of cv. Rose Prosperity ones (Table, 5), as all treatments employed in this work reduced No. days from planting to first floret open (day), but improved flowering stalk length and diameter (cm), flowering stalk fresh and dry weights (g), rachis length (cm), No. florets/flowering stalk and first floret diameter (cm) with various significant differences in the two seasons. The mastership, however in all previous characters was for the combined treatment between biogien at 15 g/plant and soaking in humic acid for 24hrs., which scored the utmost high averages over control and all other treatments in both seasons.

These findings could be also interpreted and discussed as done before in case of flowering of cv. White Prosperity plants.

Table (4): Effect of biogien, humic acid and their interactions on some vegetative growth parameters of *Gladiolus* sp. cv. Rose Prosperity plants during 2008 and 2009 seasons.

Humic acid soaking period (hours) / Biogien (g/plant)	Plant height (cm)				No. Leaves/plant				Aerial parts F.W. (g)				Aerial parts D.W. (g)			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	55.00e	56.67de	57.78cd	56.48b	8.00b	8.00b	8.33b	8.11b	43.61e	56.14d	68.70bc	56.15c	12.48d	13.67c	16.59ab	14.25b
5.0	56.67de	58.33c	64.29ba	59.76b	8.33b	8.67ab	9.00ab	8.67[a]	53.39de	59.25cd	74.21ab	62.28b	13.80c	16.07bc	18.39ab	16.09ab
10.0	57.33d	63.42bc	66.33ab	62.36a	8.67ab	8.83ab	9.67a	9.06a	59.69cd	69.00bc	80.30ab	69.66ab	14.86cb	16.96ab	18.93ab	16.92a
15.0	58.67c	65.33ab	70.00a	64.67a	8.76ab	9.00ab	10.00a	9.25a	66.10c	71.64bc	82.11a	73.28a	15.10cb	17.52ab	19.21a	17.28a
Mean	56.92c	60.94b	64.60a		8.44a	8.63a	9.25a		55.70c	64.01b	76.33a		14.06c	16.06b	18.28a	
	Second season: 2009															
0.0	57.20d	58.21d	59.30cd	58.24c	8.23b	8.19c	8.35b	8.26b	45.35e	56.33d	69.10bc	56.93c	12.98d	14.00c	17.20b	14.73b
5.0	59.00cd	60.61c	65.78b	61.80b	8.32b	8.59b	8.91ab	8.61ab	55.54d	60.78cd	75.00ab	63.77b	14.35c	16.67b	19.14a	16.72ab
10.0	59.78cd	63.00bc	69.00ab	63.92ab	8.76b	8.97ab	9.86a	9.20a	62.00c	71.50bc	81.17a	71.56ab	14.99bc	17.68b	19.71a	17.46a
15.0	61.33c	66.67b	72.69a	66.90a	8.94b	9.23ab	10.16a	9.44a	68.67cb	73.48b	81.93a	74.69a	15.70bc	18.20ab	20.31a	18.07a
Mean	59.32c	62.12b	66.69a		8.56b	8.75a	9.32a		57.89c	65.52b	76.80a		14.51c	16.64b	19.09a	

- Means within a column or row having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table (5): Effect of biogien, humic acid and their interactions on flowering of *Gladiolus* sp. cv. Rose Prosperity plants during 2008 and 2009 seasons.

Humic acid soaking periods (hours) / Biogien (g/plant)	No. days from planting to flowering				Flowering stalk length (cm)				Flowering stalk diameter (cm)				Flowering stalk F.W. (g)			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	98.00a	98.00a	97.00a	97.67a	93.60e	98.33d	105.00cb	98.98b	0.60d	0.66cd	0.76b	0.67b	34.52f	37.10e	42.85cd	38.16c
5.0	96.33a	96.00a	94.10ba	95.48a	101.70c	102.71c	111.70ab	105.37a	0.63c	0.74b	0.87ab	0.75b	36.71ef	41.03d	47.50b	41.75b
10.0	94.56ba	93.80ba	91.00b	93.12b	104.33cb	105.83bc	113.21ab	107.79a	0.69c	0.79b	0.93a	0.80a	39.00de	42.70cd	56.14a	45.95ab
15.0	93.18ba	92.33b	88.53c	91.35b	104.00cb	106.41b	116.33a	108.91a	0.73bc	0.87ab	0.97a	0.86a	39.33d	44.76c	58.50a	47.53a
Mean	95.52a	95.03a	92.66b		100.91b	103.32b	111.56a		0.66b	0.77ab	0.88a		37.39b	41.40b	51.25a	
	Second season: 2009															
0.0	97.33a	96.76a	95.50a	96.53a	95.41e	99.00d	107.12bc	100.51b	0.62c	0.67c	0.76b	0.68b	35.88e	38.50d	43.76c	39.38c
5.0	96.10a	95.50a	93.33ba	94.98a	99.83d	103.00c	113.30ab	105.38a	0.65c	0.76b	0.86ab	0.76ab	38.10de	41.88cd	48.91bc	42.96b
10.0	95.00ab	94.00ab	91.00b	93.33b	104.75c	108.15b	116.70ab	109.87a	0.70cb	0.82b	0.91a	0.81a	39.70d	43.69c	52.00b	45.13ab
15.0	93.28ba	93.00ba	89.00c	91.76b	106.80bc	109.20b	119.47a	111.82a	0.75bc	0.88ab	0.97a	0.87a	41.30cd	45.50c	56.93a	47.91a
Mean	95.43a	94.82a	92.21b		101.70b	104.84b	114.15a		0.68b	0.78ab	0.88a		38.75b	42.39b	50.40a	

Humic acid soaking periods (hours) / Biogien (g/plant)	Flowering stalk D.W. (g)				Rachis length (cm)				No. of florets per flowering stalk				First floret diameter (cm)			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	5.20d	5.61cd	7.39b	6.07b	46.67d	49.33cb	53.33b	49.78c	9.00e	10.76d	13.67c	11.14b	9.33e	11.00c	12.33b	10.89b
5.0	5.53d	6.33c	8.43ab	6.76ab	48.33c	50.67bc	58.00ab	52.33bc	10.33d	13.00cd	14.33bc	12.55b	10.33d	12.33b	13.00a	11.89a
10.0	5.96cd	7.15bc	8.99a	7.37a	49.00c	52.73b	58.33ab	53.35b	12.46cd	14.67ab	16.67ab	14.60a	11.00c	12.67ab	13.67a	12.45a
15.0	6.00c	7.43b	9.52a	7.65a	48.50c	55.00ab	63.10a	55.33a	13.00cd	15.33ab	17.67a	15.33a	11.67cb	13.00a	13.67a	12.78a
Mean	5.67b	6.63ab	8.58a		48.13c	51.93b	58.19a		11.20b	13.44ab	15.59a		10.58b	12.25a	13.17a	
	Second season: 2009															
0.0	5.31d	5.59cd	7.41b	6.10b	47.18d	50.38cd	55.16b	50.91c	9.26d	11.20c	13.46bc	11.31b	8.67c	10.36bc	11.98ab	10.34b
5.0	5.63cd	6.70bc	8.56ab	6.96ab	50.00cd	52.63c	58.90ab	53.84bc	10.60cd	13.41bc	15.00ab	13.00b	9.53c	12.00a	12.88a	11.47a
10.0	6.14c	7.51b	9.33a	7.66a	51.00cd	54.78b	60.32ab	55.37b	12.93cb	14.50b	16.98a	14.80a	10.70b	12.26a	12.90a	11.95a
15.0	6.20c	7.69b	9.78a	7.89a	52.33c	57.21b	63.97a	57.84a	13.50bc	15.91ab	17.33a	15.58a	11.30b	13.00a	13.00a	12.43a
Mean	5.82b	6.87ab	8.77a		50.13c	53.75b	59.59a		11.57b	13.76ab	15.69a		10.05b	11.91a	12.69a	

- Means within a column or row having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

3- Corm productivity:

Similar to results obtained in case of corm productivity of cv. White Prosperity plants were those results of cv. Rose Prosperity, as data in Table (6) revealed that new corm diameter (cm) and its fresh and dry weights (g) increased with either elevating biogien level or elongating the soaking period in humic acid solution with significant differences in most instances of both seasons. A similar trend occurred as well with regard to No. cormels/plant, where all treatments caused a progressive increment as either the rate of biogien or period of soaking in humic acid solution was increased. However, the superiority in all previous parameters in the two seasons was also for the combined treatment mentioned before, as it record 56.38 and 51.40 cormels/plant in the first and second seasons, respectively.

These results may be discussed as previously stated in case of corm productivity of cv. White Prosperity plants.

From the aforementioned results, it could be recommended to fertilize *Gladiolus* sp. cvs. White Prosperity and Rose Prosperity plants cultivated in the clayey soil with biogien biofertilizer at 15 g/plant, three times before flowering with one month interval and only one time immediately after flowering with soaking the corms before planting in 20 ml/l humic acid solution for 24 hrs. to get best growth, flowering and corms productivity.

Table (6): Effect of biogien, humic acid and their interactions on corm productivity of *Gladiolus* sp. cv. Rose Prosperity plants during 2008 and 2009 seasons.

Humic acid soaking period (hours) / Biogien (g/plant)	New corm diameter (cm)				New corm F.W. (g)				New corm D.W. (g)				No. cormels/plant			
	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean	0.0 h	12 h	24 h	Mean
	First season: 2008															
0.0	2.97d	3.16c	3.90ab	3.34a	10.01d	10.64cd	14.07b	11.57b	4.41c	4.68bc	5.82ab	4.97b	23.67e	27.33de	29.67d	26.89c
5.0	3.03cd	3.41bc	3.68b	3.37a	10.21d	11.61c	15.10ab	12.31ab	4.48c	5.09b	6.46ab	5.34ab	27.00de	38.00c	45.33bc	36.78b
10.0	3.27bc	3.60b	4.00a	3.62a	10.85cd	13.36bc	17.26ab	13.82a	4.79b	5.37ab	6.80a	5.65a	35.00cd	48.10b	53.67ab	45.59a
15.0	3.60b	3.83ab	4.33a	3.92a	11.49c	12.98bc	18.79a	14.42a	5.11b	5.91ab	7.10a	6.04a	37.33c	50.00b	56.38a	47.90a
Mean	3.22b	3.50b	3.98a		10.64b	12.15b	16.31a		4.70b	5.26b	6.55a		30.75c	40.86b	46.26a	
	Second season: 2009															
0.0	2.88c	3.10b	3.67ab	3.22a	9.71d	10.33c	12.76bc	10.93b	4.21c	4.50b	5.63ab	4.78b	22.90f	26.00e	30.00ed	26.30c
5.0	2.95bc	3.31b	3.78ab	3.35a	9.90d	11.50cb	13.58b	11.66b	4.28c	4.91b	6.33a	5.17ab	26.13e	35.18d	42.34bc	34.55b
10.0	3.18b	3.49ab	3.90a	3.52a	10.53c	12.89b	16.90a	13.44a	4.56b	5.13ab	6.50a	5.40a	31.95de	39.70c	48.33ab	39.99ab
15.0	3.37b	3.70ab	4.11a	3.73a	11.23c	13.10b	17.43a	13.92a	5.08ab	5.71ab	6.79a	5.86a	35.67d	46.56b	51.40a	44.54a
Mean	3.10b	3.40b	3.87a		10.34b	11.96b	15.17a		4.53b	5.06b	6.31a		29.16c	36.86b	43.02a	

- Means within a column or row having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

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استجابة نباتات الجلاديولاس صنفي "White and Rose Prosperity" لبعض معاملات التسميد

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أجريت تجربتان حقليتان بمشتل معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠٠٨، ٢٠٠٩ و ذلك لدراسة تأثير البيوجين (منتج تجاري يحتوي على سلالة معينة من بكتيريا *Azotobacter chroococcum*) عند اضافته تكبيشاً للتربة بمعدلات: صفر، ٥ ، ١٠ ، ١٥ جم/نبات، نقع الكورمات قبل الزراعة في محلول الأكتوسول (سماد عضوي سائل لحمض الهيوميك يحتوي على NPK بنسبة ١٠:١٠:١٠) بتركيز ٢٠ مل/لتر لمدة: صفر، ١٢، ٢٤ ساعة، و كذلك التفاعلات بينهما على النمو، الازهار و انتاج الكورمات لنباتات صنفي الجلاديولاس White Prosperity (زهيراته بيضاء اللون) و Rose Prosperity (زهيراته وردية). و لقد تم زراعة الكورمات في أحواض (١×١م) على عمق ٧ سم من سطح التربة و أبعاد (٢٠ × ٢٠ سم) من بعضها البعض و أضيف البيوجين

قبل الإزهار ثلاث مرات بفاصل شهر بين كل مرة و الأخرى، كما أضيف مرة واحدة فقط عقب جمع الأزهار مباشرة.

و لقد أوضحت النتائج المتحصل عليها أن جميع قياسات النمو الخضري، معبراً عنها بإرتفاع النبات (سم)، عدد الأوراق/نبات و الوزن الطازج و الجاف للأجزاء الخضرية (جم)، و كذلك قياسات الازهار، معبراً عنها بطول و قطر الحامل النوري (سم)، الوزن الطازج و الجاف للحامل النوري (جم)، طول الجزء الحامل للأزهار (سم)، عدد الزهيرات/حامل نوري و قطر أول زهيرة (سم) لكلا الصنفين قد زادت بشكل تصاعدي كلما زاد معدل اضافة البيوجين أو أطيلت مدة النقع في محلول حمض الهيوميك بفروق معنوية مختلفة في كلا الموسمين. و لقد كان العكس صحيحاً فيما يتعلق بعدد الأيام من الزراعة حتى تفتح أول زهيرة (يوم)، حيث أحدثت جميع معاملات التسميد موضع الدراسة تبكيراً معنوياً في معظم الحالات بكلا الموسمين. و لقد كانت الأفضلية في جميع القياسات السابقة للمعاملة المشتركة بين البيوجين بمعدل 15جم/نبات و النقع في حمض الهيوميك لمدة ٢٤ ساعة و التي أعطت أعلى المتوسطات على الاطلاق بكلا الموسمين و بالمثل، فان قطر الكورمة الجديدة (سم) و وزنها الطازج و الجاف (جم) و كذلك عدد الكريمات/نبات لكلا الصنفين قد زادت تصاعدياً بزيادة معدل اضافة البيوجين أو اطالة مدة النقع في حمض الهيوميك مع تفوق المعاملة المشتركة سالفة الذكر ، و التي أعطت أكبر عدد و أثقل كورمات جديدة و أكثر عدداً للكريمات/نبات.

و عليه، فإنه طبقاً لنتائج هذه الدراسة يمكن التوصية بتسميد نباتات صنفي الجلاديولاس "White-and Rose-Prosperity" المنزرعة في تربة طينية بالسماد الحيوي بيوجين بمعدل ١٥ جم/نبات، ثلاث مرات قبل الإزهار و بفاصل شهر بين كل مرة و الأخرى، و مرة واحدة فقط عقب الازهار مباشرة بشرط نقع الكورمات قبل الزراعة في محلول حمض الهيوميك (٢٠ مل/لتر) لمدة ٢٤ ساعة للحصول على أفضل نمو، ازهار و انتاج الكورمات.