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EFFECT OF SOME ORGANIC AND BIO-FERTILIZATION TREATMENTS ON GLADIOLUS PLANTS: 1- VEGETATIVE GROWTH AND FLOWERING

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ABSTRACT

A field experiment was carried out during the successive seasons of 2006 / 2007 and 2007 / 2008 to study the effect of some organic fertilizer (compost) and biofertilizers (phosphorein and / or E.M.) and their interaction on *Gladiolus grandiflorus* cv. Eurovision plant.

Results showed that vegetative growth (leaf length, number of leaves / plant and leaves dry weight) and flowering aspects (length of spike, flowering part length of spike, number of florets / spike, lower floret diameter and single floret fresh weight) were gradually increased by increasing the level of organic fertilizer.

All biofertilization treatments significantly increased all vegetative growth characters and flowering parameters in comparison with the control. Phosphorein plus E.M. seemed more effective in this concern.

Flowering date was delayed due to compost treatments, while flowering date was not significant affected by biofertilization treatments. It was found that the use of high level of compost in combination with biofertilizers noticeably improved the different vegetative growth characters and flowering parameters of gladiolus plants.

INTRODUCTION

Gladiolus grandiflorus, L. plants are considered one of the most important flowering bulbs grown in Egypt. Gladiolus belongs to Family Iridaceae and is propagated by corms. It has decorative spike which carries numerous florets. There are fast expands in areas planted with gladiolus in Egypt in order to meet the increase demand for gladiolus flowers local market and exportation.

Organic and biofertilization are among the important agricultural treatments which have been proved to improve the vegetative growth and flowering aspects of gladiolus plants.

Many investigators revealed the importance of organic fertilization on the growth and flowering quality of gladiolus. Gangadharan and Gopinath (2000), Conte *et al.* (2001), Zaghloul and Moghazy (2001), Zaghloul and Atta–Alla *et al.* (2001) Pimpini and Zanin (2002) and Atta–Alla *et al.* (2003) reported that treated *Gladiolus grandiflorus* plants with organic fertilization resulted a significant increase in plant height, number of leaves, leaf area, fresh and dry weights of whole plant, as well as, spike length, and number of florets / spike. Similar results were confirmed by Nabih (1991) on *Freesia refracta*, Gomaa (2000) on *Ornithogalum thyrsides* and Nasr (2001) and Abd El–Karim (2001) on tuberose plants.

Concerning the effect of biofertilizers, Kathiresan *et al.* (2002), Abdou *et al.* (2004) and Taha and Hassan (2008) found that biofertilization treatments improved vegetative growth and flower characters of gladiolus. Similar results were obtained on other flowering bulbs such as tuberose

plants (Wang and Patil, 1994 and El–Naggar, 1998) and narcissus (El–Naggar and Mahmoud, 1994).

The aim of the present study was to investigate the effect of organic fertilizer (compost) and biofertilizer treatments on the vegetative growth and flowering of gladiolus cultivar, Eurovision.

MATERIALS AND METHODS

A filed experiment was carried out during the two successive seasons of 2006 / 2007 and 2007 / 2008 at the Nursery of ornamental plants, Fac. Agric., Minia Univ. to figure out the response of *Gladiolus grandiflorus* cv. Eurovision plants to organic and bio-fertilization treatments.

The corms of gladiolus were obtained from Holland by Basiony nurseries, Cairo, Egypt. Average corm diameter was 2.8 and 2.7 cm and corm weight was 7.3 and 9.1 g for the first season and second one, respectively. Corms were planted on Nov. 3rd for both seasons in 1.8 × 2 m plots containing 3 ridges, 50 cm apart, corms were planted in hills, 20 cm apart (8 corms / ridge). Physical and chemical properties of the soil used are listed in Table (A). The split plot design with three replicates was followed in this experiment.

Table (A) : Physical and chemical properties of the experimental soil.

Soil properties	Value	Soil properties		Value
Sand %	15.56	Ex Ca mg / 100g soil		17.92
Silt %	39.98	Total N %		0.14
Clay %	44.46	Avail. P ppm.		19.12
Texture grade	Clay loame	Extr. k mg / 100 g soil		2.17
Organic matter %	1.51			
Ca Co_3 %	1.45	DTPA	Fe	8.75
E. C. m mhos / cm	0.67	Ext. ppm	Zn	2.99
pH (1 : 2.5)	8.02		Mn	25.65

The four levels of compost fertilization treatments were considered as main plots and the four biofertilization treatments were the sub-plots. The four levels of compost treatments were 0.0, 4, 8 and 12 t / fed. The compost was added before planting during the soil preparation. Compost analysis shown in Table (B).

Table (B): Chemical analysis of the compost (Average the two seasons)

pH	Humidity %	Organic matter %	N%	P%	K%	Fe ppm	Mn ppm	Cu ppm	Zn ppm	C/N
8.3	26	65	2.15	1.5	1.26	1025	115	180	28	1:16

The biofertilization treatments were as follows :

1- Without any biofertilizer (control), 2- Phosphorein, 3- Effect of microorganisms (E.M.), 4- Phosphorein + E.M.

The biofertilizers were applied three times to the soil beside the plants at 6.4 kg / fed. of phosphorein and / or 50 cm^3 / plant of E.M.

The soil applied was carried out three times, one month and two months after planting and after flower cut.

Effective microorganisms (E.M.) is a biofertilizer containing photosynthetic bacteria, lactic acid and yeasts, and 1 ml contain 10^7 cells of bacteria. This biofertilizer was obtained from the Laboratory of Biofertilizers, Department of Genetics, Fac. Agric., Minia Univ.

Phosphorein is a biofertilizer containing phosphate dissolving bacteria and was obtained from Ministry of Agriculture.

The following data were recorded :

1- Vegetative growth characters just before flowering : leaf length (cm), number of leaves per plant and dry weight of leaves(g) /plant.
2- Flowering characters : flowering date (day), spike length (cm), flowering part length of spike (cm), number of florets / spike, lower floret diameter (cm) and single floret fresh weight (g).

The data of the two experiments were subjected to the statistical analysis of variance using MSTAT–C (1986). L.S.D. test at 0.05 was used to compare the average means of treatments.

RESULTS AND DISCUSSION

1- Vegetative growth characters :

Data in Table (1) show that leaf length, number of leaves / plant and leaves dry weight / plant of gladiolus were significantly increased in both seasons due to the use of compost at 4, 8 and 12 t / fed. in comparison with those of untreated plants. Moreover the increase was gradually by the gradual increase in compost levels. The increase in vegetative growth traits due to compost at levels of 4, 8 and 12 t / fed. over the control reached 14.45, 25.94 and 30.94 % for leaf length, 18.57, 22.80 and 27.85 % for number of leaves and 18.71, 23.13 and 28.23 % for leaves dry weight, respectively, in the first season and reached 13.34, 26.10 and 32.10 % for leaf length, 16.95, 20.06 and 24.11 % for number of leaves and 17.21, 20.13 and 24.35 % for leaves dry weight, respectively, in the second one. Similar results were found by Gangadharan and Gopinath (2000), Conte *et al.* (2001), Zaghloul and Moghazy (2001) and Atta–Alla *et al.* (2003.

The increase of vegetative growth resulting from using compost as organic fertilization treatments might be due to organic matter is considered as important factor for improving physical, chemical and biological properties of soil and consequently, increasing plant growth (Maynard, 1991).

Data in Table (1) indicated that, leaf length, number of leaves / plant and leaves dry weight of gladiolus were significantly increased, in both seasons, due to the use of each phosphorein, E.M. and phosphorein + E.M. treatments in comparison with untreated control. The combined treatment of phosphorein + E.M. seemed to be more effective than biofertilizer alone. In conformity with these results were those declared by Kathiresan *et al.* (2002), Abdou *et al.* (2004) and Taha and Hassan (2008).

Table (1): Effect of organic and biofertilization treatments on leaf length, number of leaves / plant and leaves dry weight of gladiolus plants during 2006/2007 and 2007/2008 seasons.

Biofertilizers	Level of compost									
	1st season					2nd season				
	0.0	4 t/fed.	8 t/fed.	12 t/fed.	Mean B	0.0	4 t/fed.	8 t/fed.	12 t/fed.	Mean B
	Leaf length (cm)									
Control	20.41	23.68	26.38	28.57	24.76	20.86	24.15	27.89	30.49	25.85
Phosphorein	23.52	27.08	29.45	31.28	27.83	24.05	27.56	30.95	32.94	28.88
E.M.	26.04	29.65	32.87	33.47	30.51	26.85	30.11	33.18	33.96	31.03
Phos.+ E.M.	28.55	32.36	35.36	35.66	32.98	29.56	33.01	35.75	36.45	33.69
Mean (A)	24.63	28.19	31.02	32.25		25.33	28.71	31.94	33.46	
L.S.D. 5 %	A: 1.23	B: 1.35		AB: 2.70		A: 1.50	B: 1.71		AB: 3.42	
	Number of leaves / plant									
Control	5.21	6.35	6.78	7.15	6.37	5.43	6.55	6.87	7.31	6.54
Phosphorein	6.02	7.13	7.47	7.76	7.10	6.33	7.43	7.65	7.92	7.33
E.M.	6.43	7.62	7.75	8.05	7.46	6.74	7.85	7.97	8.23	7.70
Phos.+ E.M.	6.91	8.40	8.16	8.45	7.88	7.23	8.26	8.37	8.47	8.08
Mean (A)	6.14	7.28	7.54	7.85		6.43	7.52	7.72	7.98	
L.S.D. 5 %	A: 0.30	B: 0.36		AB: 0.72		A: 0.33	B: 0.28		AB: 0.56	
	Leaves dry weight (g / plant)									
Control	2.48	3.04	3.25	3.42	3.05	2.60	3.14	3.29	3.50	3.13
Phosphorein	2.88	3.42	3.59	3.73	3.41	3.03	3.57	3.67	3.81	3.62
E.M.	3.07	3.64	3.71	3.85	3.57	3.22	3.75	3.81	3.94	3.68
Phos.+ E.M.	3.31	3.84	3.92	4.07	3.79	3.47	3.96	4.02	4.08	3.88
Mean (A)	2.94	3.49	3.62	3.77		3.08	3.61	3.70	3.83	
L.S.D. 5 %	A: 0.15	B: 0.18		AB: N.S		A: 0.12			AB: N.S	

Phos. = Phosphorein
E. M. = Effective microorganisms

The role of E.M. (as a biofertilizer containing different strains of photosynthetic bacteria, lactic acid bacteria and yeasts) or phosphorein (as a biofertilizer containing phosphate solubilizing bacteria) in promoting vegetative growth might be attributed to the increase in nutrient uptake and also to synthesis of plant growth regulators. Consequently, increasing the formation of metabolites which encourage the vegetative growth and enhance meristematic activity of cell and tissues to improve leaf production (Sperenat, 1997, Hassan, 1997 and Gabra, 2004).

The interaction between compost and biofertilization treatments was significant in the two seasons for leaf length and number of leaves / plant, while it non significant in the two seasons for leaves dry weight. Moreover, the maximum leaf length, number of leaves / plant and leaves dry weight / plant, in both seasons, were obtained due to supplying the soil of gladiolus with high level of compost (12 t / fed.) in combination with the phosphorein plus E.M. followed by medium level (8 t / fed.) combined with phosphorein + E.M. then high level of compost with E.M.

2- Flowering parameters :

Data in Table (2) show that flowering date (number of days from planting till the opening of the first floret) was significantly delayed, in both seasons, as a result of compost fertilization treatments comparing with control (untreatment). All compost levels treatments caused significant increases in length of spike, flowering part length of spike, number of florets / plant, lower floret diameter and single floret fresh weight, in the two seasons, in comparison with that of untreated plants as shown in Tables (2 and 3).

Table (2): Effect of organic and biofertilization treatments on flowering date, length of spike and flowering part length of spike of gladiolus plants during 2006/2007 and 2007/2008 seasons.

Biofertilizers	Level of compost									
	1st season					2nd season				
	0.0	4 t/fed.	8 t/fed.	12 t/fed.	Mean B	0.0	4 t/fed.	8 t/fed.	12 t/fed.	Mean B
Flowering date (day)										
Control	112.0	116.2	118.3	120.4	116.7	112.8	115.6	118.2	120.9	116.9
Phosphorein	112.7	117.1	119.4	121.5	117.7	113.7	116.5	119.3	121.7	117.8
E.M.	114.9	119.5	121.7	123.8	120.0	115.9	118.8	121.6	124.1	120.1
Phos.+ E.M.	115.5	119.9	122.0	124.1	120.4	116.7	119.5	122.2	124.6	120.8
Mean (A)	113.8	118.2	120.4	122.5		114.8	117.6	120.3	122.8	
L.S.D. 5 %	A: 0.8	B: N.S	AB: N.S			A: 0.9	B: N.S	AB: N.S		
Length of spike (cm)										
Control	62.11	68.18	72.13	74.61	69.26	63.50	70.40	73.16	75.19	70.56
Phosphorein	65.17	72.16	75.19	76.52	72.26	66.70	74.31	75.10	77.02	73.28
E.M.	67.23	74.65	77.55	78.71	74.54	68.81	76.83	77.51	79.13	75.57
Phos.+ E.M.	69.51	75.06	79.91	80.70	76.30	71.13	79.21	79.95	81.15	77.86
Mean (A)	66.01	72.51	76.20	77.64		67.54	75.19	76.43	78.12	
L.S.D. 5 %	A: 1.13	B: 0.92	AB: 1.84			A: 1.18	B: 0.90	AB: 1.80		
Flowering part length of spike (cm)										
Control	37.88	42.27	44.36	45.88	42.60	38.74	43.30	45.21	46.62	43.47
Phosphorein	39.75	44.74	46.24	47.54	44.57	40.69	45.70	46.42	47.75	45.14
E.M.	41.10	46.28	46.69	48.91	46.00	41.98	47.25	47.91	49.10	46.56
Phos.+ E.M.	42.51	46.55	49.15	50.13	47.09	43.40	48.71	49.41	50.31	47.96
Mean (A)	40.31	44.96	46.86	48.12		41.20	46.24	47.24	48.45	
L.S.D. 5 %	A: 1.88	B: 0.95	AB: 1.80			A: 1.20	B: 0.81	AB: 1.62		

Phos. = Phosphorein
E. M. = Effective microorganisms

Table (3): Effect of organic and biofertilization treatments on number of florets / spike, lower floret diameter and single floret fresh weight of gladiolus plants during 2006/2007 and 2007/2008 seasons.

Biofertilizers	Level of compost									
	1st season					2nd season				
	0.0	4 t/fed.	8 t/fed.	12 t/fed.	Mean B	0.0	4 t/fed.	8 t/fed.	12 t/fed.	Mean B
Number of florets / spike										
Control	6.31	7.22	7.91	8.52	7.49	6.48	7.35	8.06	8.68	7.64
Phosphorein	7.72	8.67	9.38	10.02	8.95	7.90	8.80	10.53	11.18	9.60
E.M.	8.03	8.99	9.71	10.36	9.27	8.21	9.13	10.87	11.53	9.94
Phos.+ E.M.	8.36	9.35	10.06	10.70	9.61	8.54	9.49	11.22	11.87	10.28
Mean (A)	7.61	8.56	9.27	9.90		7.78	8.69	10.17	10.82	
L.S.D. 5 %	A: 0.43	B: 0.21		AB: N.S		A: 0.61	B: 0.33		AB: N.S	
Lower floret diameter (cm)										
Control	5.83	6.53	7.04	7.44	6.71	5.94	6.62	7.10	7.51	6.79
Phosphorein	6.32	7.33	7.65	7.86	7.29	6.45	7.43	7.73	7.91	7.38
E.M.	6.53	7.53	7.83	8.05	7.49	6.66	7.65	7.98	8.15	7.61
Phos.+ E.M.	6.62	7.66	8.05	8.20	7.63	6.77	7.80	8.10	8.40	7.77
Mean (A)	6.33	7.26	7.64	7.89		6.44	7.38	7.72	7.99	
L.S.D. 5 %	A: 0.36	B: 50		AB: 1.0		A: 0.45	B: 0.54		AB: 1.08	
Single floret fresh weight (g)										
Control	4.13	4.71	5.10	5.43	4.62	4.22	4.78	5.15	5.48	4.91
Phosphorein	4.60	5.35	5.62	5.81	5.35	4.70	5.42	5.68	5.85	5.41
E.M.	4.88	5.65	5.91	6.10	5.64	4.98	5.74	6.01	6.18	5.73
Phos.+ E.M.	5.03	5.82	6.14	6.37	5.84	5.08	5.96	6.19	6.47	5.93
Mean (A)	4.66	5.38	5.69	5.93		4.75	5.48	5.76	6.00	
L.S.D. 5 %	A: 0.28	B: 0.21		AB: 0.42		A: 36	B: 0.19		AB: 0.38	

Phos. = Phosphorein
E. M. = Effective microorganisms

The flowering parameters were gradually increased according to the increase in levels of compost fertilizer. However, non significant differences were detected between the high and medium levels for flowering aspects in most cases. These results are in close with those obtained by Zaghloul and Moghazy (2001), Pimpini and Zanin (2002) and Atta–Alla *et al.* (2003) on gladiolus, Nabih (1991) on *Freesia refracta*, Goma (2000) on *Ornithogalum thyrsides* and Nasr (2001) and Abd El–Karim (2001) on tuberose plants.

A possible explanation to the positive effect of compost fertilizer treatments might be attributed to its stimulative effect on different vegetative growth (Table, 1). Better vegetative growth should be directly reflected on various flowering aspects.

Regarding to biofertilization treatments, data in Table (2) revealed that flowering date was not significantly affected by such treatments in the two seasons. Kathiresan *et al.* (2002), Abdou *et al.* (2004) and Taha and Hassan (2008) on gladiolus plants came to similar results that flowering date was not affected by biofertilizer. All biofertilizer treatments significantly increased length of spike, flowering part length of spike, number of florets / spike and lower florets diameter, as well as, single floret fresh weight compared with untreated plants. The highest values for all flowering characters were obtained due to gladiolus plants treated with phosphorein + E.M. followed by E.M. then phosphorein. Similar results were obtained in the second season.

This finding was similar to those obtained by Abdou *et al.* (2004) and Taha and Hassan (2008) on gladiolus and Swaminathan *et al.* (1999) on tuberose.

These results may be attributed to the direct and indirect role of substances (nutrients, amino acids, auxin and gibberellins) came as a result from inoculation of microorganisms (Spernat, 1997), all those have better effects on the plant growth, consequently improving enzymatic system that reflected on the flower quality and quantity.

The interaction between the main two factors was significant in the two seasons for the different studied flowering characters, except for flowering date and number of florets per spike as shown in Tables (2 and 3). The best overall results were obtained due to the use of compost at high or medium level in combination with phosphorein + E.M. Generally, it is very important to mention that, high or medium level of compost with phosphorein + E.M. are economically and environmently required and beneficial. Also, biofertilizers increased the activity of organic fertilizer in improvement the vegetative growth and flowering of gladiolus plants.

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تأثير بعض معاملات التسميد العضوى والحيوى على نباتات الجلاديولس:
١ - النمو الخضرى والتزهير

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تم إجراء تجربة حقلية خلال موسمين متتاليين ٢٠٠٦ / ٢٠٠٧ و٢٠٠٧ / ٢٠٠٨ بمشتل الزينة بكلية الزراعة جامعة المنيا وذلك بهدف دراسة تأثير بعض معاملات التسميد العضوى (كمبوست) والحيوى (فوسفورين و الكائنات الحية الدقيقة الفعالة .E.M أو هما معا) كذلك تأثير التداخل بين الكمبوست والتسميد الحيوى على نبات الجلاديولس جراندفلورس صنف أيروفيشن .

وقد أظهرت النتائج أن صفات النمو الخضرى (طول الورقة وعدد الأوراق/ نبات والوزن الجاف للأوراق/نبات وكذلك صفات التزهير (طول الشمراخ وطول الجزء الحامل للزهيرات وعدد الزهيرات للشمراخ وقطر الزهيرة السفلى والوزن الطازج للزهيرة ازداد تدريجيا بزيادة مستوى التسميد العضوى الصناعى (كمبوست) .

كما أدت كل معاملات التسميد الحيوى إلى زيادة معنوية لكل صفات النمو الخضرى وقياسات الأزهار مقارنة بمعاملة الكنترول وبدت معاملة الفوسفورين مع الكائنات الحية الدقيقة الفعالة .E.M أكثر تأثيرا فى ذلك .

أظهرت النتائج أيضا حدوث تأخير فى موعد التزهير نتيجة استعمال التسميد العضوى الصناعى (كمبوست) بينما لم يتأثر معنويا باستعمال الأسمدة الحيوية .

وأخيرا وجد أن استعمال المعدل المرتفع من التسميد العضوى الصناعى (كمبوست) مع الفوسفورين والكائنات الحية الدقيقة الفعالة .E.M أدى إلى تحسن فى مختلف صفات النمو الخضرى والزهرى لنباتات الجلاديولس .