

## EFFECT OF DIFFERENT PLANTING DATES AND SOME NATURAL EXTRACTS ON THE QUALITY OF GLADIOLUS GROWTH, FLOWERING AND CORMS PRODUCTIVITY

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*Scientific J. Flowers & Ornamental Plants*,  
10(2):163-170 (2023).

**Received:**

13/4/2023

**Accepted:**

4/6/2023

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**ABSTRACT:** A pot experiment was performed in the open field of Ornamental Plants and Landscape Gardening Research Department Nursery, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt, during 2019/2020 and 2020/2021 seasons to improve the quality of *Gladiolus grandiflorus* 'Peters Pears' growth and flowering. To achieve this goal different planting dates (July, October and February) and various soil drench additions (yeast and garlic extracts) were employed, while different parameters i.e. plant height (cm), leaf number/plant, spike stem length (cm), spike fresh and dry weights (g), corms fresh and dry weights (g), and pigments content of the fresh leaves (chlorophyll a, b and carotenoids; mg/g f.w.) were measured. The obtained results showed that planting on 15<sup>th</sup> October in addition to soil drenching with yeast extract produced the highest values in most studied characters except for corms' fresh and dry weights (g) which were increased by planting on 15<sup>th</sup> February in addition to soil drenching with yeast extract. So, to obtain the best results it is recommended to plant *Gladiolus grandiflorus* 'Peters Pears' corms on 15<sup>th</sup> October in addition to soil drenching with yeast extract (2 g/l three times at 15-day intervals).

**Keywords:** *Gladiolus grandiflorus*, planting dates, garlic extract, yeast extract, vegetative growth, flowering, corms

### INTRODUCTION

*Gladiolus* (*Gladiolus grandiflorus* Andrews), often known as the sword lily, is a beautiful bulbous plant from Africa that belongs to the iris family (Iridaceae). The plant has more than ten sword-shaped leaves as it is about to bloom. *Gladiolus* could be grown in tiny spaces because of its short cycle (on average between 60 and 80 days) and quick financial return. When producing cut flowers or new corms, plants can reproduce asexually from corms or cormels (Lorenzi and Souza, 2008).

The growth and quality of *gladiolus* are greatly influenced by the planting date (Khan *et al.*, 2008). The response of *gladiolus* to planting date was reported by Salvi *et al.*

(2003) on *Gladiolus grandiflorus* 'American Beauty', 'Her-Majesty' and 'Jester', Barzegar *et al.* (2006) on *Gladiolus grandiflorus* cv. Oscar, Zubair *et al.* (2006 a) *Gladiolus grandiflorus* cvs. Deciso, Hong Kong, Jessica, Jester Ruffled, Madonna, Peters Pears, Rose Supreme, and White Friendship and Ivanova *et al.* (2016) on *gladiolus* cvs. Iva and Ekaterina. In this regard, proper planting time enhances *gladiolus* vegetative growth and quality, meets customer demands (Zubair *et al.*, 2006 b). However, planting in April to May produced the most spikes per plant, planting in March and April produced the most tuberous corms per plant (Mukhopadhyay and Banker, 1981). Like other plants, *gladiolus* growth and yield depend on when they are planted.

Active dry yeast could be considered one of the most important natural bio-stimulants used in agriculture. Yeast may gain this superiority by containing large amounts of nutrients, protein, vitamin B and endogenous hormones such as cytokinins (Ahmed, 2002). In this context, El-Sayed (2010) reported the values of the most important ingredients in active dry yeast as 47% protein, 33% carbohydrates, 8% minerals, 0.001 mg/g vitamin B12 and 60-100 ml/g thiamine.

Garlic extract is widely used in the agriculture field. Extracts derived from garlic include growth substances, phytohormones, and vitamins (Safithri *et al.*, 2011). Also, Sulphur amino acids such as cysteine, and methionine are present in garlic bulbs (Abdulrazzaq, 2017).

This work aimed to improve the quality of *Gladiolus grandiflora* growth, flowers and corms by applying different planting dates and some natural extracts of active dry yeast and garlic.

## MATERIALS AND METHODS

A pot experiment was performed in the open field of Ornamental Plants and Landscape Gardening Research Department Nursery, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt, during 2019/2020 and 2020/2021 seasons to improve the quality of *Gladiolus grandiflorus* 'Peters Pears' growth and flowering by applying different planting dates (July, October and February) and soil drench additions (yeast and garlic extracts).

### Materials:

Corms with 8-9 cm circumference were obtained directly before planting for each specific date from a local floriculture

company in Giza, Egypt. After obtaining, the corms were cleaned and fast-soaked for 1 minute in Rizolex© fungicide at 1 g/l then planted under open field conditions in 25-cm-plastic pots (one corm/pot) containing equal amounts of clay + sand by volume. Table (a) shows the analysis of the clay and sand (sandy clayey soil). One month after planting, all plants were fertilized with 2 g/pot of a commercial NPK (19:19:19) fertilizer.

### Experimental design and treatments:

This experiment was laid out as a two factors completely randomized design the first factor was assigned for the three planting dates (mid-July, mid-October and mid-February), while the second one was allocated for the three soil drenching treatments with yeast extract, garlic extract as well as distilled water (control). So, this experiment contains 9 treatments (3 planting dates × 3 extracts), each treatment contained three replicates, each one containing 5 corms.

Yeast extract was prepared by dissolving commercial active dry yeast (2 g)/1 liter distilled water according the method described by Selim (2016), while garlic extract was prepared according to Saeed *et al.* (2014). Drenching with different natural extracts was applied at 500 ml/pot for 3 times, the first one was done after one month from planting then at 15-day intervals.

### Data recorded:

At the beginning of the spike sprout, plant height (cm), leaf number/plant and pigments content (chlorophyll a, b and carotenoids; mg/g) in fresh leaves were measured. In this regard, pigments content was determined according to Wellburn and Lichtenthaler (1984). When the basal florets on the spike

**Table a. Physical and chemical properties of the used clay and sand.**

Soil type	Particle size distribution (%)				S.P.	E.C (ds/m)	pH	Cations (meq/l)				Anions (meq/l)		
	Coarse sand	Fine sand	Silt	Clay				Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	K <sup>+</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>
Sand	89.03	2.05	0.40	5.52	25.00	7.75	6.73	11.11	6.08	58.20	10.34	0.96	58.99	25.78
Clay	7.54	22.28	30.55	39.63	40.00	7.80	1.97	4.96	3.10	10.64	1.09	1.02	1.32	7.45

were opened, spike stem length (cm) and fresh and dry weights of spikes (g) were recorded.

Two months after the spikes were cut and after the foliage was dried, the corms were harvested and fresh and dry weights of the corms (g) were measured.

#### **Statistical analysis:**

SAS program (1994) was used to statistically analyze the tabulated data, while L.S.D. method (Snedecor and Cochran, 1980) was used to compare the means.

## **RESULTS AND DISCUSSION**

#### **Influence of planting dates:**

Data registered in Tables (1-4) show that the effect of planting dates was significant. Planting gladiolus corms on 15<sup>th</sup> October seems to be the preferred planting date for plant height, leaf number, spike stem length, fresh and dry weights of spike, chlorophyll a, b and carotenoids as recorded the highest values (72.80 and 73.80 cm, 6.61 and 7.62, 78.14 and 79.14 cm, 29.73 and 30.74 g, 3.69 and 3.74 g, 0.89 and 0.92 mg/g f.w., 0.57 and 0.57 mg/g f.w. and 0.66 and 0.66 mg/g f.w. in both seasons, respectively). While, planting on 15<sup>th</sup> February produced the highest values for the corms fresh and dry weights (40.88 and 41.87 g and 11.86 and 12.27 g, in both seasons, respectively).

#### **Influence of natural extracts:**

Soil drenching with yeast extract seems to be superior in enhancing all studied traits as produced the highest values in both seasons. The values were 75.27 and 76.27 cm for plant height, 7.52 and 8.50 for leaf number/plant, 81.89 and 82.88 cm for spike stem length, 33.49 and 34.46 g for spike fresh weight, 4.01 and 4.29 g for spike dry weights, 41.74 and 42.80 g for corms fresh, 13.02 and 13.08 g for dry weights, 0.91 and 0.95 mg/g f.w. for chlorophyll a, 0.58 and 0.58 mg/g f.w. for chlorophyll b and 0.69 and 0.68 mg/g f.w. for carotenoids in both seasons, respectively (Tables, 1-4).

#### **Influence of interaction between planting dates and natural extracts:**

As for the effect of interaction treatments (Tables, 1-4), planting on 15<sup>th</sup> October and soil drenching with yeast extract resulted in the highest values for most studied traits specifically plant height, leaf number, spike stem length, spike fresh and dry weights, chlorophyll a, b and carotenoids (78.10 and 79.11 cm, 8.08 and 9.42, 84.12 and 85.43 cm, 36.19 and 37.21 g, 4.34 and 4.60 g, 0.93 and 0.97 mg/g f.w., 0.60 and 0.59 mg/g f.w. and 0.71 and 0.70 mg/g f.w. in both seasons, respectively). These previous effects were significant with some other interaction treatments and insignificant with other ones. It is also worth mentioning that planting on 15<sup>th</sup> October and soil drenching with garlic extract shared the previously mentioned treatment in its effect without significant differences between them especially for plant height and spike stem length in both seasons. On the other hand, the highest values of corms' fresh and dry weights were obtained by planting on 15<sup>th</sup> February and soil drenching in both seasons (44.09 and 45.25 and 13.51 and 14.15 g, respectively).

The lowest values in this regard were obtained by planting on 15<sup>th</sup> July without soil drenching with any natural extracts for the most studied traits except for plant height, spike stem length and chlorophyll b (in the second season only). In general, the lowest values were obtained when the soil drenching with natural extract was not applied.

The present study showed a superior effect of 15-October planting on vegetative growth and flowering quality. These results were in harmony with those obtained by Misra (1996) who reported that on *Gladiolus* cv. Christian Jane, flower quality was highest with planting on 15-Oct. compared to 15-Feb. On the other hand, Nijasure and Ranpise (2005) on *Gladiolus grandiflorus* cv. American Beauty reported that planting corms on 15 October was found to be superior for plant height, leaf number and spike length. Dalal *et al.* (2006) recorded that corms of gladiolus cvs. American Beauty, Majesty and

**Table 1. Effect of planting dates and some natural extracts on plant height and leaf number of *Gladiolus grandiflorus* ‘Peters Pears’ during 2019/2020 and 2020/2021 seasons.**

Treatments	Plant height (cm)		Leaf number		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	
<b>Planting dates</b>					
15 <sup>th</sup> July	69.10	70.10	5.71	6.49	
15 <sup>th</sup> October	72.80	73.80	6.61	7.62	
15 <sup>th</sup> February	67.93	68.93	6.60	7.55	
L.S.D. 0.05	5.60	6.32	0.52	0.65	
<b>Natural extracts</b>					
Control	65.67	66.67	5.05	6.11	
Yeast	75.27	76.27	7.52	8.50	
Garlic	68.90	69.90	6.35	7.04	
L.S.D. 0.05	5.60	6.32	0.52	0.65	
<b>Planting dates × natural Extracts</b>					
15 <sup>th</sup> July	Control	66.00	67.00	4.02	5.10
	Yeast	71.31	72.31	7.36	8.07
	Garlic	70.00	71.00	5.75	6.30
15 <sup>th</sup> October	Control	70.00	71.00	5.23	6.19
	Yeast	78.10	79.11	8.08	9.42
	Garlic	70.30	71.30	6.51	7.24
15 <sup>th</sup> February	Control	61.00	62.00	5.89	7.05
	Yeast	76.40	77.40	7.13	8.02
	Garlic	66.40	67.40	6.78	7.58
L.S.D. 0.05	9.15	10.35	1.09	1.26	

**Table 2. Effect of planting dates and some natural extracts on spike stem length, spike fresh and dry weights of *Gladiolus grandiflorus* ‘Peters Pears’ during 2019/2020 and 2020/2021 seasons.**

Treatments	Spike stem length (cm)		Spike fresh weight (g)		Spike dry weight (g)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	
<b>Planting dates</b>							
15 <sup>th</sup> July	76.51	77.48	25.50	25.77	2.69	2.93	
15 <sup>th</sup> October	78.14	79.14	29.73	30.74	3.69	3.74	
15 <sup>th</sup> February	77.82	78.85	29.50	30.44	3.16	3.65	
L.S.D. 0.05	4.35	5.32	3.22	4.31	0.50	0.45	
<b>Natural extracts</b>							
Control	72.40	73.59	25.13	26.00	2.74	2.67	
Yeast	81.89	82.88	33.49	34.46	4.01	4.29	
Garlic	78.17	79.00	26.10	26.48	2.79	3.35	
L.S.D. 0.05	4.35	5.32	3.22	4.31	0.50	0.45	
<b>Planting dates × natural Extracts</b>							
15 <sup>th</sup> July	Control	72.30	73.11	21.40	22.00	2.14	2.42
	Yeast	80.00	81.33	31.00	32.00	3.77	3.80
	Garlic	77.22	78.00	24.10	23.30	2.17	2.56
15 <sup>th</sup> October	Control	71.00	72.00	25.00	26.00	3.33	2.89
	Yeast	84.12	85.43	36.19	37.21	4.34	4.60
	Garlic	79.30	80.00	28.00	29.00	3.41	3.72
15 <sup>th</sup> February	Control	73.89	75.67	29.00	30.00	2.75	2.70
	Yeast	81.56	81.89	33.29	34.18	3.93	4.48
	Garlic	78.00	79.00	26.21	27.14	2.79	3.76
L.S.D. 0.05	8.62	9.29	6.25	8.19	0.86	0.78	

**Table 3. Effect of planting dates and some natural extracts on corms fresh and dry weights of *Gladiolus grandiflorus* ‘Peters Pears’ during 2019/2020 and 2020/2021 seasons.**

Treatments	Corms fresh weight (g)		Corms dry weight (g)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	
<b>Planting dates</b>					
15 <sup>th</sup> July	34.07	34.92	11.15	10.87	
15 <sup>th</sup> October	36.71	37.54	11.25	11.36	
15 <sup>th</sup> February	40.88	41.87	11.86	12.27	
L.S.D. 0.05	2.43	3.09	0.23	0.14	
<b>Natural extracts</b>					
Control	34.36	35.20	9.47	9.95	
Yeast	41.74	42.80	13.02	13.08	
Garlic	35.56	36.34	11.77	11.47	
L.S.D. 0.05	2.43	3.09	0.23	0.14	
<b>Planting dates × natural Extracts</b>					
15 <sup>th</sup> July	Control	31.03	31.75	9.88	9.11
	Yeast	40.06	41.20	12.41	12.31
	Garlic	31.11	31.82	11.15	11.21
15 <sup>th</sup> October	Control	33.00	33.78	8.62	9.99
	Yeast	41.07	41.95	13.14	12.79
	Garlic	36.05	36.90	11.98	11.30
15 <sup>th</sup> February	Control	39.04	40.08	9.90	10.76
	Yeast	44.09	45.25	13.51	14.15
	Garlic	39.51	40.29	12.17	11.90
L.S.D. 0.05	4.25	6.90	0.39	0.24	

**Table 4. Effect of planting dates and some natural extracts on pigments content in leaves of *Gladiolus grandiflorus* ‘Peters Pears’ during 2019/2020 and 2020/2021 seasons.**

Treatments	Chlorophyll a (mg/g f.w.)		Chlorophyll b (mg/g f.w.)		Carotenoids (mg/g f.w.)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	
<b>Planting dates</b>							
15 <sup>th</sup> July	0.85	0.88	0.55	0.55	0.61	0.63	
15 <sup>th</sup> October	0.89	0.92	0.57	0.57	0.66	0.66	
15 <sup>th</sup> February	0.84	0.88	0.54	0.55	0.64	0.66	
<b>Natural extracts</b>							
Control	0.83	0.86	0.53	0.54	0.59	0.62	
Yeast	0.91	0.95	0.58	0.58	0.69	0.68	
Garlic	0.85	0.88	0.54	0.55	0.64	0.64	
<b>Planting dates × natural Extracts</b>							
15 <sup>th</sup> July	Control	0.82	0.85	0.53	0.52	0.55	0.60
	Yeast	0.89	0.93	0.57	0.58	0.67	0.67
	Garlic	0.84	0.86	0.54	0.55	0.62	0.62
15 <sup>th</sup> October	Control	0.87	0.89	0.55	0.57	0.61	0.63
	Yeast	0.93	0.97	0.60	0.59	0.71	0.70
	Garlic	0.87	0.90	0.56	0.56	0.66	0.65
15 <sup>th</sup> February	Control	0.80	0.83	0.51	0.53	0.61	0.64
	Yeast	0.90	0.94	0.57	0.58	0.68	0.68
	Garlic	0.83	0.87	0.53	0.55	0.64	0.65

Jester planted on 15 October produced the highest spike length than those planted on 30 September. Also, Zubair, *et al.* (2006 b) found that planting Gladiolus cvs. Jester Ruffled and Rose Supreme on 1 November produced maximum spike lengths. Kumar (2019) showed that planting gladiolus cvs. Nova Lux, White Prosperity, Rose Supreme, American Beauty and Big Time Supreme from 5<sup>th</sup> October to 5<sup>th</sup> November resulted in the maximum vegetative growth and flowering values especially plant height, leaf number and spike length.

Also, it could be observed from the results obtained from this study that planting on 15<sup>th</sup> Feb. was more suitable for corm parameters, this was previously confirmed by Vita (1981) who reported that in gladiolus cv. White Prosperity the best planting date for corms was obtained from 10<sup>th</sup> January to 20<sup>th</sup> February.

The timing of planting varies according to photoperiods, temperatures, and light levels. Gladiolus corms of a better size can be harvested from plantings in February and March, according to Talia and Traversa (1986).

Abdou *et al.* (2021 a and b) on *Gladiolus grandiflorus*, cv. Eurovision found that the highest values were obtained of leaf length, leaf number/plant, spike length, spike fresh weight, corms characteristics, chlorophylls a, b and carotenoids by active dry yeast at 5 g/l as a foliar spray. Also, Ibrahim and Tawfik (2021) on gladiolus 'White Prosperity' reported that yeast extract at 5 g/l as foliar application showed a great positive influence on spike length, spike fresh weight, corm fresh and dry weights.

The observed positive impact of yeast extract on gladiolus plant growth may be attributed to its rich content of cytokinins, which are known to promote cell division and stimulate the growth of axillary buds. Moreover, yeast extract contains other essential components such as vitamin B, proteins, and nutrients, all of which contribute to improved gladiolus growth and corm

production, as noted by Ahmed (2002). This, in turn, results in enhanced photosynthesis, cell division, and overall improvements in growth, flowering, and corm parameters. Further insight into the impact of yeast extract on the tissues of different plants was provided by Al-Shewailly (2020), who documented a substantial increment of gladiolus parenchymal cells' diameter in the vascular bundle and mesophyll tissues when the plants were treated with yeast extract at 7 g/l.

In conclusion, it is recommended to plant *Gladiolus grandiflora* 'Peters Pears' corms in 15<sup>th</sup> October in addition to soil drenching with yeast extract at 2 g/l three times with 15-day intervals to get the best results regarding vegetative growth and flowers.

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### تأثير مواعيد الزراعة المختلفة وبعض المستخلصات الطبيعية على جودة النمو، الإزهار وإنتاجية كورمات الجلاديولاس

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تم اجراء تجربته أصص بالحقل المكشوف بمشتل قسم بحوث الزينة وتنسيق الحدائق، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي نمو ٢٠٢٠/٢٠١٩ و ٢٠٢١/٢٠٢٠ لتحسين جودة النمو والإزهار لنبات الجلاديولاس. ولتحقيق هذا الهدف تم زراعته الكورمات في ثلاث مواعيد مختلفه (يوليو، أكتوبر وفبراير) وتم إضافة بعض المستخلصات لتربة الزراعة (الخميرة والثوم)، هذا وقد تم تسجيل القياسات التالية: طول الورقة (سم)، عدد الأوراق/نبات، طول الساق الزهري (سم)، الوزن الطازج والجاف للساق الزهري (جم)، الوزن الطازج والجاف للكورمات (جم) ومحتوى الأوراق من الكلوروفيللات أ، ب والكاروتينويدات (ملجم/جم). أظهرت النتائج التي تم الحصول عليها أن الزراعة في منتصف أكتوبر مع إضافة مستخلص الخميرة إلى تربة الزراعة أدت الى الحصول على أعلى القيم التي تم دراستها فيما عدا الوزن الطازج والجاف للكورمات والتي حققت أعلى القيم بالزراعة في منتصف فبراير مع اضافته مستخلص الخميره للتربة. لهذا، وللحصول على أفضل النتائج فإنه يُوصى بزراعة كورمات الجلاديولاس في منتصف أكتوبر مع إضافة مستخلص الخميرة (٢ جم/لتر ثلاث مرات كل ١٥ يوم) لبيئة النمو للحصول على أفضل صفات النمو الخضري والزهري ومحتوى الصبغات لنبات الجلاديولاس.