Effect of Some Fertilizer Treatments on the Growth of Cormels of *Gladiolus* and Corms Production

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ABSTRACT

The present experiment was performed throughout two successive seasons of 2013/2014 and 2014/2015 at the nursery of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt to investigate the effects of different concentrations of some fertilizer treatments alone or with some combinations between them on the vegetative growth, corms production and some chemical constituents of gladioli cormels. The used plant was *Gladiolus grandiflorus* cv."Rose Supreme" for its popularity in Cairo and Alexandria flower trade. The cormels of the used cultivar were planted in 25 cm. plastic pots filled with an equal mixture of sand and agricultural soil. After one month from planting the fertilizer treatments were started as a soil drench at 333.3 ml/plant and repeated five times at 15 days' interval. The fertilizer treatments were kristalon at 2 g/l, actosol at 2.5 ml/l or 5 ml/l and yeast extract at 5 or 10 g/l alone or with some combinations between them (13 treatments) . The experiment layout was designed to provide complete randomized blocks containing three replicates, each replicate had 13 different treatments and four cormels were used for each treatment in each replicate(plot).

Results revealed that using yeast extract at 10 g/l combined with kristalon at 2g/l gave the highest significant increases of plant height, leaves number and the content of the produced corms of phosphorus, potassium and total carbohydrates, compared with the control treatment. While using yeast extract at 10 g/l combined with actosol at 2.5 ml/l achieved the largest circumference of the produced corms (grade number), corms dry weight and the number of cormels/plant, compared with the control treatment.

Besides, using yeast extract at 5g/l combined with actosol (2.5 or 5.0 ml/l) gave the highest corms fresh weight, and leaves total carotenoids content, compared with the control treatment. Furthermore, using actosol alone (2.5 or 5.0 ml/l) gave the highest significant values of chlorophyll (a + b) in the leaves, nitrogen in the corms and cormels fresh weight, compared with the control treatment.

From the aforementioned results it can be generally recommended to fertilize *Gladiolus grandiflorus* cv." Rose Supreme" cormels with yeast extract at 5 to 10 g/l (8.35 to 16.66 g/plant/season) combined with actosol at 2.5 to 5 ml/l (4.15 to 8.35 ml/plant/season) at 333.3 ml/plant/time five times to obtain corms with high quality.

Key words: *Gladiolus grandiflorus*, Bio, organic and chemical fertilization.

INTRODUCTION

Gladiolus plant belongs to family Iridaceae and considered as one of the most important flowering bulbs grown in Egypt.

Gladiolus genus probably involved about 250 species originated in the Mediterranean region, tropical and South Africa and being cultivated in different countries. Flowers are funnel type shaped commonly showy, red, purple, yellow, white and other colors (Bailey, 1971). The most important problem faced the production of gladiolus in Egypt is the deterioration of corms production year after year. Therefore, they are annually imported from Netherlands. But in view of rising prices of corms in recent years, studying the factor that may help to produce high corms yield and quality locally is very necessary.

The commercial preparation of kristalon 19:19:19 (a complete fertilizer with macro and micro elements) proved its superiority for improving quality of various ornamental bulbs as mentioned by many scientists (Soliman, 2002 on *Iris tingitana* cv. Purple Sensation and Mansour *et al.* 2015) on *Gladiolus grandifloras* cv. Peter Pears). Such great effect of kristalon might be attributed to its content of N, P and K as they play a major role in growth and development of any plant. Besides, micronutrients content which also play an important role in most vital processes of plants although they are needed in small quantities (Marscher, 1995).

Also, yeast extract proved its mastery in most cases for improving most plant traits compared with that gained from most of other extracts of different plant species, as it contains cytokinins which effectively promote plant growth in addition to its high nutrient contents, high protein, large amount of vitamin B and other natural plant growth regulators such as cytokinins (Ahmed, 2002). Atowa (2012) on *Freesia refracta* cv. Red Lion recorded that using yeast extract at 2.5 g/l proved its mastery for improving vegetative growth and corms and cormlets productivity. Receiving plants yeast extract at 5 g/l was the best for raising chlorophyll (a and b) in leaves. N, P and K contents in leaves were

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also increased as a result of applying yeast extract at 2.5 g/l.

Actosol is an organic fertilizer containing humic acid and other nutritional elements (El-Seginy, 2006). Using actosol seems to be valuable in correcting the widespread occurrence of certain deficiency symptoms. This is attained through increasing the soil water holding capacity, improving soil structure and enhancing the metabolic activity of microorganisms. It also acts as a source of nitrogen, phosphorus, sulfur and other elements for plants (Petrovic *et al*, 1982; Higa and Wididana, 1991). Moreover, Stevenson (1994) concluded that, humic substances isolated from different materials contained 45-65% carbon, 30-48% oxygen, 2-6% nitrogen and 5% hydrogen. Humic substances (HS) are important as a soil component because they constitute a stable fraction of carbon (C), thus regulating the carbon cycle and release of nutrients including nitrogen (N), phosphorus (P) and Sulphur (S). Additionally, the presence of HS improves pH buffering and thermal insulation. Dorer and Peacock (1977) added that humate, a salt of humic acid reactions is one of several humic substances which can provide soil microbes with energy and improve nutrients retension in the soil. In this connection, many efforts had been done on the effect of actosol on plant growth of various plant species. Hanel and Muller (2006) observed that *Gladiolus imbricatus* grew well in moderately and strongly acidic humic acid. Eliwa *et al.* (2009), on *Iris tingitana* cv. Wedgewood concluded that supplying the plant with actosol as a foliar spray at the rate of 2.5 ml/l was the best treatment for increasing plant height and number of leaves/plant. El-Sayed *et al.* (2010) on two Gladiolus cvs. (White and Rose Prosperity), concluded that 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 increased vegetative growth parameters.

Therefore, the work embodied in this paper aimed to estimate how far using some chemical (kristalon), organic (actosol) and bio fertilizer (yeast) treatments can improve gladiolus corms yield and quality, under local condition for achieving the hope of solving one of the most important problem faced the production of gladiolus corms in Egypt i.e. the deterioration of corms productivity year after year, with decreasing the high cost of importing corms from abroad annually.

MATERIALS AND METHODS

The experimental trial was consummated throughout two successive seasons (2013/2014 and 2014/2015) at the nursery of Horticulture Research Institute, Agriculture Research center, Giza, Egypt. It aimed to study the effects of three different types of fertilizers i.e. a chemical fertilizer (the commercial preparation of kristalon, 19:19:19), an organic fertilizer (actosol), a bio stimulant (active dry yeast) and some of their combinations on cormels of *Gladiolus grandiflorus* cv."Rose Supreme" for possibility of production corms with good quality**.**

The used plant was cormels (small corms arising on stolons which develop between the mother and daughter corms, they usually graded into three sizes: large ≥3.14cm circumference; medium, ≥1.89 and < 3.14 cm; and small, < 1.89 cm "Larson, 1980") of *Gladiolus grandiflorus* cv. Rose Supreme for its popularity in flower trade in Cairo and Alexandria. The used cormels had uniform sizes and shapes and they were obtained from a commercial nursery in Cairo, which were imported them from Netherlands.

The average circumference of the chosen cormels were 2.4 cm in the two experimental seasons. The cormels were planted at a depth of 5cm in 25 cm plastic pots that were filled with about 3 Kg of the used medium. The plants stayed at open field condition for 6 months after planting time. All the normal culture practices of growing *Gladiolus* cormels were applied as usual manner.

The used medium for planting the cormels was a sandy loamy soil (clay=3.4%, silt=30.1% and sand 66.5%) and the chemical analysis of it is shown in Tables A and B.

Three types of fertilizers were used in this experiment i.e. kristalon as a chemical fertilizer (19N: 19 P_2O_5: 19 K_2O: 0.01 Cu: 0.25 B: 0.01 MO) was used at 2 g/l, actosol as a liquid organic fertilizer (Table C) and yeast extract as a bio fertilizer at 5 and 10 g/l which was prepared by dissolving 5 and 10 g active dry yeast separately in 100 ml warm water (40°C) in 250 ml beakers for each. About 3 g sugar was added to the beaker. It was kept in dark warm place for 24 hrs. then the content of the beaker was filtered into one litre measuring flask and completed with water to one litre final volume and it was applied as a soil drench. The chemical composition of the used active dry yeast in the two seasons is presented in Table (D).

The cormels were planted on November 5th 2013 and 2014 for the two seasons under open filed condition. After sprouting the cormels and formation of 2-3 leaves per plant (December 5th) the different fertilizer treatments were applied as a soil drench at 333.3 ml/plant which represented 75.7% of the field capacity and repeated 5 times at 15 days' interval till February 5th of the next year (2014 and 2015 for the two seasons, respectively).

Table A.The chemical analysis of the used medium

pH	E.C. (dsm^{-1})	Cations (meq/l)				Anions (meq/l)		
		Ca++	Mg++	Na+	K+	HCO_3^-	Cl^-	SO_4^{--}
7.81	1.84	3.35	1.53	4.69	2.25	3.88	4.38	3.56

Table B. The available macro-and micro nutrients in the used medium

Macronutrients (ppm)		Micronutrients (ppm)				
N	P	K	Fe	Zn	Mn	Cu
130.7	23.4	380.0	6.15	5.70	9.40	3.68

Table C. Main characteristics of the used liquid organic fertilizer (Actosol) according to El-Seginy (2006)

Components	Value	Components	Value	Components	Value
Humic acid (%)	2.9	E.c. (dsm^{-1})	5.90	B (mg/l)	70.00
Organic matter/total solids (%)	42.51	N (%)	10.00	Fe (mg/l)	900.00
Total HA/total solids (%)	16.88	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		

Table D.Chemical composition of the used active dry yeast (El-Sayed *et al.*2010*)*

Minerals mg /g							
Cu	8.0	Na	0.12	Niacin	300-500 mg/g.	Proteins	47%
Se	0.1	Ca	0.75	Pyrodoxin	28.0 mg/g.	Carbohydrates	33.0%
Mn	0.02	Fe	0.02	Pantathenate	70.0 mg/g.	Minerals	8.0%
Cr	2.2	Mg	1.65	Bioton	1.3 mg/g.	Nucleic acids	8.0%
Ni	3.0	K	21.0	Cholin	40.0 mg/g.	Lipids	4.0%
Va	0.04	P	13.50	Folic acid	5.13 mg/g.		
Mo	0.4	S	3.9	Vit B12	0.001 mg/g.		
Sn	3.0	Zn	0.17	Thiamine	60-100 ml/g.		
Li	0.17	Si	0.03	Riboflavin	35-50 ml/g.		

The different treatments were:

T_1-Untreated plants "control" (the plants were irrigated only with tap water).

T_2- Kristalon at 2 g/l (equal 0.67 g/plant/time and 3.35 g/plant/season).

T_3-Actosol at 2.5 ml/l (equal 0.83 ml/plant/time and 4.15 ml/plant/season).

T_4-Actosol at 5 ml/l (equal 1.67 ml/plant/time and 8.35 ml/plant/season).

T_5 –Yeast extract at 5 g/l (equal 1.67 g/plant/time and 8.35g/ plant/season).

T_6-Yeast extract at 10 g/l (equal 3.33g/plant/time and 16.65 g/plant/season).

T_7-Yeast extract at 5g/l +actosol at 2.5 ml/l.

T_8-Yeast extract at 5 g/l+ actosol at 5 ml/l.

T_9-Yeast extract at 10 g/l+ actosol at 2.5 ml/l.

T_{10}- Yeast extract at 10 g/l+ actosol at 5 ml/l.

T_{11}-Yeast extract at 10 g/l+ kristalon 2 g/l.

T_{12}-Actosol 5 ml/l+ kristalon 2 g/l.

T_{13}-Yeast extract at 10 g/l+ actosol at 5 ml/l+ kristalon 2 g/l.

Data collected were:

Vegetative growth (plant) height (cm), number of leaves per plant, corms circumference (cm), corms grade, corms fresh and dry weights (g), number of cormels per plant and cormels fresh weight (g).

Chlorophyll (a and b) and total carotenoids content (mg/g fresh weight) were determined in the plants fresh leaves of the different treatments under the experiment (98 days after planting) according to Wettstein (1957).

Total carbohydrates content was determined calorimetrically as percentage in the produced corms according to Smith *et al.* (1956).

Nitrogen content in the new corms was determined by micro-Kjeldahle apparatus as described by Black (1965). Phosphorus was calorimetrically determined in the produced corms using ascorbic acid method as reported by John (1970). Potassium content in the corms was determined using flame photometer as described by Dewis and Freitas (1970).

The experimental layout was designed to provide complete randomized blocks containing three replicates, each replicate contained 13 different treatments. Four cormels were used as a plot for each treatment in each replicate. Data were statistically analyzed using SAS (2009) computer program and the means of individual factor was compared by L.S.D. test at 5% level of probability (*Snedecor* and *Cochran*, 1980).

RESULTS AND DISCUSSION

Vegetative growth parameters:

Data of the two seasons exhibited in Table (1) show that using yeast extract at 10 g/l combined with kristalon at 2 g/l gave rise to the utmost high values of plant height in the two seasons, which led to increase the plant height by14.74 and 19.62% over the control treatment in the first and second seasons, respectively. Furthermore, data also showed that using yeast extract at 5 or 10 g/l combined with actosol (at 2.5 or 5 ml/l) or kristalon combined with yeast extract at 10 g/l or with actosol at 5 ml/l gave significant increases in plant height of *Gladiolus grandiflorus* cv. "Rose Supreme " plants, compared with the control treatment. These results were probably due to that the aforementioned treatments led to increase of N, P, K and others nutritional elements in the root zone as well as cytokinins and vitamins, which are considered plant growth regulators, and in turn increased plant height. In this connection, Ahmed (2002), attributed the positive effects of applying yeast to the plant to its high nutrient content, high protein, large amount of vitamin B and natural plant growth regulators such as cytokinins. Similar trend of results was reported by El-Sayed *et al.* (2010) and Mansour *et al.* (2015) on gladiolus plants.

Besides, data of the two seasons in Table (1) showed that almost all the fertilizer treatments gave significant increases of leaves number/plant, compared with the control treatment. While using yeast extract at 10 g/l combined with kristalon at 2 g/l gave the maximum increase of the number of leaves per plant in the two seasons, which led to increase the leaves number per plant by 21.43 and 34.67% over the control treatment in the first and second seasons, respectively.

Table 1. Effect of kristalon, actosol and yeast extract treatments on plant height ,number of leaves/plant corm fresh and corm dry weights of *Gladiolus grandiflorus* cv. "Rose Supreme" during the two seasons (2013/2014 – 2014/2015)

Treatments	Plant height (cm)		No .of leaves /plant		Corm fresh weight (g)		Corm dry weight (g)	
	1st season	2nd Season	1st season	2nd season	1st season	2nd season	1st season	2nd Season
Control	62.75	57.75	7.00	6.00	12.18	11.64	4.69	3.19
Kristalon 2 g/l	64.50	59.50	7.58	7.33	14.63	12.74	5.60	3.85
Actosol 2.5 ml/l	63.58	58.58	7.50	6.91	14.99	12.30	6.01	4.30
Actosol 5 ml/l	63.50	61.50	7.75	7.25	19.60	17.28	7.15	5.73
Yeast 5 g/l	65.66	60.66	7.66	7.66	16.11	14.30	6.11	4.69
Yeast 10 g/l	70.75	65.75	8.08	7.41	14.72	12.66	5.37	4.28
Yeast 5 g/l +Actosol 2.5 ml/l	68.58	62.91	7.91	7.75	21.77	19.11	7.38	6.43
Yeast 5 g/l +Actosol 5 ml/l	69.58	64.91	7.41	7.00	19.54	17.12	7.18	6.16
Yeast 10 g/l +Actosol 2.5 ml/l	71.40	67.08	7.75	7.58	20.55	18.85	7.39	6.97
Yeast 10 g/l +Actosol 5 ml/l	65.95	63.62	7.25	7.25	14.18	12.56	5.55	4.25
Yeast 10 g/l +kristalon 2g/l	72.00	69.08	8.50	8.08	16.52	14.82	6.07	4.66
Actosol 5 ml/l +Kristalon 2 g/l	69.75	66.00	7.16	7.00	15.95	13.61	5.66	3.80
Yeast 10 g/l+Actosol 5 ml/l+Kristalon 2g/l	65.33	59.33	7.66	7.41	14.54	12.86	5.79	4.01
L.S.D at 0.05	4.47	5.01	0.48	0.57	4.11	2.98	1.43	0.96

L.S.D. Least Significant Differences at 0.05 Probability.

The great results in this concern may be due to the excess of nitrogen and other elements as well as growth regulators from yeast extract, which had positive effects on the rate of photosynthesis and cell division, consequently the number of leaves per plant could be increased. These results agree with those reported by Mohamed *et al*. (2005) on *Lilium,*Eliwa *et al*. (2009) on *Iris tingitana* and El-Naggar and El-Nasharty (2009) on *Hippeastrum vittatum*.

Corms and cormels production:

Corm fresh weight was affected by the different fertilizer treatments in both seasons. Generally, great influence was detected on the obtained values due to supplying plants with either actosol at 5 ml/l alone or with that of the combination of yeast extract at 5 g/l+ actosol at2.5 ml/l or that of yeast extract at5g/l +actosol at 5 ml/ l, as well as the combination of yeast extract at 10 g/l+ actosol at 2.5 ml/l. Meanwhile, the lowest effects for improving the same trait were concomitant to plants which supplied with kristalon at 2 g/l, actosol at 2.5 ml/l, yeast extract at 10 g/l and the combination of yeast extract at 10 g/l + actosol at 5 ml/l. The other treatments, on the other hand, gave an intermediate effect in this regard.

However, data of the two seasons in Table (1) showed that using yeast extract at 5 g/l combined with actosol at 2.5 ml/l gave the maximum corm fresh weight of gladiolus plant, compared with the other treatments used, which led to increase the corm fresh weight by 78.75% and 64.05% over the control treatment in the first and second seasons, respectively. These results were probably due to the translocation of more carbohydrates and soluble nitrogen compounds from leaves to corms, consequently the corms fresh weight could be increased.

The previous results agree with those reported by El-Sayed *et al.* (2010), Ali *et al.* (2014) and Saeed *et al.* (2014) on Gladiolus plant.

Generally, results of the two seasons in Table (1) showed that using actosol alone at 5 ml /l or combined with yeast extract at 5 g/l or actosol at 2.5 ml/l combined with yeast extract at 5 or 10 g g/l gave significantly increases in the value of corms dry weight, compared with the other treatments. Also, data of the two seasons in Table (1) indicated that using yeast extract at 10 g/l combined with actosol at 2.5 ml/l gave the maximum corm dry weight of *Gladiolus* plant, compared with the other treatments, which led to increase the corm dry weight by 57.64% and 118.49% over the control treatment in the first and second season, respectively. These results may be due to the positive effect of the used materials at a suitable concentration on activation of the photosynthesis process. Consequently, more sugar and carbohydrates materials could be storage in the corms, thus the corm dry weight would be incremented.

Similar trend of results was reported by El-Sayed *et al.* (2010), Atowa (2012) and Saeed *et al.* (2014) on bulbs plant.

With respect to corm circumference (cm) and their grade number as influenced by fertilizer treatments, it is evident from data tabulated in Table (2) that using yeast extract at 10 g/l combined with actosol at 2.5 ml/l gave the maximum corm circumference of *Gladiolus* plant, compared with that gained from the other treatments used, which led to increase the corm circumference by 17.02% and 23.89% over the control treatment in the first and second seasons, respectively. Moreover, it could be mentioned that receiving plants the combinations of either yeast extract at 5 g/l+ actosol at 2.5 ml/l, or yeast extract at 5 g/l+ actosol at 5 ml/l were also from the best treatments used in improving such parameter in both seasons.

The aforementioned results reveal the beneficial effect of either actosol or yeast extract in raising corm circumference in most cases. However, El-Sayed *et al.* (2010) on two Gladiolus cvs. (White and Rose Prosperity), reported that soaking the corms before planting in actosol solution at the rate of 20 ml/l for 0, 12 and 24 hours increased new corm diameter. Also, *Saeed et al.* (2014) on *Gladiolus* cv. Novalux concluded that, actosol treatment at 2.5 ml/l as a soil drench proved its superiority in increasing corms quality. Additionally, Bazaraa *et al.* (2014) on *Gladiolus* cv. Novalux. reported that using the highest level of yeast extract (5 g/l) proved its superiority in raising corm circumference.

Also, data of the two seasons in Table (2) indicated that using each of yeast extract at 5 g/l alone, or yeast extract at 5 or 10 g/l combined with actosol at 2.5 or 5 ml/l, or with kristalon at 2 g/l, or actosol at 5 ml/l combined with kristalon at 2 g/l gave the highest quality of the produced corms (grades number ranged between No. 1 and No.2 according to the North American Gladiolus Council, which arranges the flowering Gladiolus corms on their diameter (cm) to 4 grades i.e. Jumbo >5.1 ,No.1 >3.8 to ≤ 5.1 No.2 >3.2 to ≤ 3.8 and No.3 >2.5 to ≤ 3.2 cm "Larson,1980"), compared with the other treatments.

These results were probably due to the role of the used materials at the specific level on activation the vegetative growth of the *Gladiolus* plants.

Table 2. Effect of kristalon, actosol and yeast extract treatments on corm circumference, grade number, corm fresh weight number of cormels / plant and cormels fresh weight /plant of *Gladiolus grandiflorus* cv. Rose Supreme during the two seasons (2013/2014-2014/2015)

Treatments	Corm circumference (cm)				Corm fresh weight (g).		Number of cormels/plant		Cormels fresh weight(g)/plant	
	1st season	Grade No.	2nd season	Grade No.	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	11.28	2	9.00	3	12.18	11.64	18.00	15.66	3.37	2.93
Kristalon 2 g/l	12.17	1	9.58	3	14.63	12.74	23.00	21.00	4.80	3.99
Actosol 2.5 ml/l	11.85	2	9.35	3	14.99	12.30	32.33	29.67	7.54	6.36
Actosol 5 ml/l	12.81	1	9.75	3	19.60	17.28	31.66	28.00	8.24	6.95
Yeast 5 g/l	11.44	2	10.21	2	16.11	14.30	37.67	34.66	9.08	7.07
Yeast 10 g/l	11.86	2	9.57	3	14.72	12.66	24.00	24.66	4.59	4.22
Yeast 5 g/l +Actosol 2.5 ml/l	12.74	1	10.45	2	21.77	19.11	33.67	31.00	8.08	7.66
Yeast 5 g/l +Actosol 5 ml/l	12.85	1	10.78	2	19.54	17.12	36.67	32.66	7.43	6.37
Yeast 10 g/l +Actosol 2.5 ml/l	13.20	1	11.15	2	20.55	18.85	38.00	36.00	8.59	8.47
Yeast 10 g/l +Actosol 5 ml/l	11.67	2	9.15	3	14.18	12.56	34.00	29.00	7.39	5.68
Yeast 10 g/l +kristalon 2g/l	12.19	1	10.07	2	16.52	14.82	30.33	27.33	6.29	5.51
Actosol 5 ml/l +Kristalon 2 g/l	12.40	1	10.20	2	15.95	13.61	37.00	33.33	7.31	5.70
Yeast 10 g/l+Actosol 5 ml/l+Kristalon 2g/l	11.65	2	9.17	3	14.54	12.86	23.00	20.00	5.16	4.48
L.S.D at 0.05	1.02		0.82		4.11	2.98	10.07	10.00	2.69	2.72

L.S.D. Least Significant Differences at 0.05 Probability.

Consequently, the size of the produced corms could be increased. Similar trend of results was reported by Saeed et al. (2014) on *Gladiolus* plant.

With respect to the effect of fertilization on number of the produced cormels/plant. It is obvious from data registered in Table (2) that the maximum number of cormels per plant was found with using yeast extract at 10 g/l combined with actosol at 2.5 ml/l, compared with the other treatments used. This result was probably due to that using yeast extract with actosol each at a suitable concentration led to active the vegetative growth of gladioli plant, consequently the number of the produced cormels per plant could be increased.

Similar trend of results was reported by El-Sayed *et al.* (2010), Bazaraa *et al.* (2012) on Gladiolus and Barsoom (2014) on tuberose.

Referring the effect of fertilization on fresh weight of cormels (g)/plant, it could be mentioned that using actosol at 5 ml/l alone or in combinations with yeast extract at 5 or 10 g/l gave significant increases on the fresh weight of cormels/plant compared with the control treatment, while the other treatments had no significant effect on this trait (Table2). These results may be probably due to the role of the used actosol at a suitable concentration on improvement of the used medium and supplying the gladiolus plant with different nutritional elements, thus the vegetative growth would be activated. Consequently, the plants could produce larger cormels.

Similar trend of results was reported by Eliwa *et al.* (2009), on *Iris tingitana* cv. Wedgewood, El-Sayed *et al.* (2010) on two *Gladiolus* cvs. (White and Rose Prosperity) and Bazaraa *et al.* (2012) on *Gladiolus* cv. Novalux

Chemical constituents:

Chlorophyll and carotenoids content:

As shown from data of the two seasons exhibited in Table (3) using actosol at 2.5 ml/l alone or in combination with yeast extract at 5 or 10 g/l or using yeast extract at 5 g/l alone led to significant increase the content of chlorophyll "a" in *Gladiolus* leaves, compared with the control treatment.

Also, there were no significant differences between the aforementioned treatments (No. 3, 5, 7 and 9 Table, 3). These results may be probably due to the role of the used actosol and or yeast extract at a suitable concentration, which they consider as sources for nitrogen, magnesium, carbon and other materials needed for chlorophyll formation, consequently the value of chlorophyll" a" could be increased. Similar trend of results was reported by Abbass (2008) on *Narcissus tazetta* and Barsoom (2014) on *Hymenocallis speciosa* bulb.

Besides, data outlined in Table (3) showed that using actosol at 2.5 ml gave the maximum chlorophyll "b" value in *Gladiolus* leaves, compared with the other treatments in the two seasons (Table 3). These results were probably due to that actosol contains nitrogen, magnesium, carbon as structural components of chlorophyll and other elements needed for chlorophyll "b" formation, consequently, the value of chlorophyll "b" in *Gladiolus* leaves could be increased. Similar trend of results was reported by Eliwa *et al.* (2009), on *Iris tingitana* cv. Wedgewood.

Furthermore, data of the two seasons in Table (3) indicated that using actosol at 5 ml/l alone, or yeast extract at 5 g/l or 10 g/l alone or in combination with actosol (at 2.5 or 5 ml/l), led to significant increase the content of total carotenoids in Gladiolus leaves, compared with the control treatment. Also, there were no significant differences between the aforementioned treatments. These results may be probably due to the role of the used materials in activation the rate of photosynthesis process in leaves, consequently the prepared food materials could be increased. Thus the value of the synthesized carotenoid would be increased. Similar trend of results was reported by Atowa (2012) on *Freesia refracta* cv. "Red Lion".

Table 3. Effect of kristalon, actosol and yeast extract treatments on chlorophyll "a", "b", total carotenoids and total carbohydrates contents of *Gladiolus grandiflorus* cv. "Rose Supreme" during the two seasons (2013/2014 and 2014/2015)

Treatments	Chlorophyll (a) mg/g.f.w.(leaves)		Chlorophyll (b) mg/g.f.w.(leaves)		Total carotenoids mg/g.f.w.(leaves)		Total carbohydrates %(corms).	
	1st season	2 nd season	1st season	2nd season	1st season	2nd season	1st season	2nd Season
Control	0.53	0.54	0.27	0.26	0.22	0.21	50.85	47.68
Kristalon 2 g/l	0.60	0.61	0.30	0.28	0.28	0.29	66.68	58.76
Actosol 2.5 ml/l	0.82	0.86	0.52	0.54	0.26	0.21	57.78	54.55
Actosol 5 ml/l	0.64	0.63	0.45	0.45	0.33	0.31	79.86	62.57
Yeast 5 g/l	0.71	0.73	0.48	0.49	0.36	0.33	70.48	57.72
Yeast 10 g/l	0.67	0.67	0.35	0.36	0.35	0.32	81.22	69.55
Yeast 5 g/l +Actosol 2.5 ml/l	0.75	0.79	0.50	0.51	0.26	0.27	76.50	61.84
Yeast 5 g/l +Actosol 5 ml/l	0.61	0.63	0.40	0.43	0.38	0.36	80.05	67.53
Yeast 10 g/l +Actosol 2.5 ml/l	0.73	0.75	0.49	0.50	0.31	0.30	82.38	77.91
Yeast 10 g/l +Actosol 5 ml/l	0.65	0.69	0.39	0.40	0.27	0.25	75.38	61.76
Yeast 10 g/l +kristalon 2g/l	0.55	0.57	0.29	0.32	0.23	0.24	85.02	79.54
Actosol 5 ml/l +Kristalon 2 g/l	0.59	0.60	0.33	0.35	0.24	0.22	74.49	61.60
Yeast 10 g/l+Actosol 5 ml/l+Kristalon 2g/l	0.61	0.62	0.42	0.43	0.32	0.34	69.64	56.66
L.S.D at 0.05	0.149	0.153	0.126	0.102	0.095	0.079	0.27	0.75

L.S.D Least Significant Differences at 0.05 Probability

Mineral elements content in the produced corms:

Generally, the obtained results presented in Table (4) indicated that using actosol at 2.5 ml/l alone gave the maximum percentage of nitrogen in the produced corms in the two seasons, compared with the control treatment, which led to increase the percentage of nitrogen by 106.59% and 69.44% over the control treatment in the first and second seasons, respectively. These results might be attributed to the role of actosol at a suitable concentration on activation of plant growth and promotion of nitrogen absorption and translocation, consequently the nitrogen content of the produced corms could be increased. Similar trend of results was reported by Eliwa *et al.* (2009) and Saeed *et al.* (2014) on *Gladiolus* plant.

Besides, data registered in Table (4) showed that almost all the used fertilizer treatments caused an increment of phosphorus percentage in the produced corms, compared with the control treatment in the two seasons. Also, using yeast extract at 10 g/l combined with kristalon at 2 g/l or yeast extract at 5 g/l combined with actosol at 2.5 ml/l gave the maximum significant increases in the phosphorus content of the produced corms, compared with the other treatments. These results may be due to that the aforementioned treatments led to increase the available phosphorus in the root zone, consequently the gladiolus plant could uptake and translocate more phosphorus in its organs (leaves and corms). Similar trend of results was reported by Barsoom (2014) on *Hymenocallis speciosa*.

Furthermore, data of the two seasons presented in Table (4) showed that almost all the used fertilizer treatments gave significant increases in the percentage of potassium content in the produced corms, compared with the control treatments. Obviously, the results of the two seasons exhibited in Table (4) indicated that using yeast extract at 10 g//l combined with kristalon at 2 g/l gave the maximum potassium percentage (1.90%) in the produced corms, compared with the control treatments. The same treatment led to increase potassium percentage in the produced corms by 42.86% over the control treatment as a mean of the two seasons. These results may be probably due to the role of the used materials (yeast extract and /or kristalon) at suitable concentrations. Bio fertilizer led to increase the supply or availability of the primary nutrients, while kristalon provides the plants with available potassium (K_2O), consequently, the gladioli plant could absorb and translocate more potassium in its corms. Similar trend of results was reported by Eliwa *et al.* (2009) on *Iris tingitana* cv. Wedgewood, and Bazaraa *et al.* (2012 and 2014) on *Gladiolus* cv. Novalux.

Table 4. Effect of kristalon, actosol and yeast extract treatments on N, P and K contents in the produced corms of *Gladiolus grandiflorus* cv. "Rose Supreme" during the two seasons (2013/2014 – 2014/2015)

Treatments	Nitrogen%		Phosphorus%		P0tassium %	
	1st season	2 nd season	1st season	2nd season	1st season	2nd season
Control	1.82	2.16	0.32	0.37	1.27	1.38
Kristalon 2 g/l	2.12	2.35	0.36	0.39	1.44	1.40
Actosol 2.5 ml/l	3.76	3.66	0.54	0.60	1.81	1.75
Actosol 5 ml/l	2.84	2.85	0.40	0.46	1.58	1.64
Yeast 5 g/l	3.08	3.23	0.43	0.48	1.73	1.69
Yeast 10 g/l	2.83	2.79	0.53	0.56	1.70	1.67
Yeast 5 g/l +Actosol 2.5 ml/l	3.47	3.58	0.63	0.61	1.75	1.70
Yeast 5 g/l +Actosol 5 ml/l	2.80	2.78	0.54	0.58	1.53	1.55
Yeast 10 g/l +Actosol 2.5 ml/l	3.28	3.43	0.46	0.53	1.78	1.49
Yeast 10 g/l +Actosol 5 ml/l	2.70	2.60	0.39	0.42	1.46	1.44
Yeast 10 g/l +kristalon 2g/l	2.74	2.63	0.70	0.69	1.84	1.95
Actosol 5 ml/l +Kristalon 2 g/l	2.31	2.39	0.48	0.56	1.80	1.87
Yeast 10 g/l+Actosol 5 ml/l+Kristalon 2g/l	2.51	2.54	0.46	0.49	1.56	1.57
L.S.D at 0.05	0.62	0.60	0.08	0.09	0.27	0.16

L.S.D Least Significant Differences at 0.05 Probability.

Total carbohydrates content (%):

It is evident from data presented in Table (3) that all the used fertilizer treatments significantly increased total carbohydrates content of the produced corms, compared with the control treatment in the two seasons. Generally, result presented in Table (3) exert that using yeast extract at 10 g/l combined with kristalon at 2 g/l gave the maximum value of total carbohydrates content in the produced corms, compared with the other treatments which led to increase the corm carbohydrate content by 67.20% and 66.82% over the control treatment in the first and second seasons, respectively. These results might be attributed to both the activation of enzymes of carbohydrate formation or regulation of the consumption of sugars and promotion of water and carbon dioxide absorption which could be led to increase the capacity of gladiolus plant in building metabolites, consequently the content of total carbohydrates in the produced corms could be increased. Similar trend of results was reported by Bazaraa *et al.* (2012 and 2014) on Gladiolus plant.

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الملخص العربي

تأثير بعض المعاملات السمادية على نمو كورمات الجلاديولس وإنتاج الكورمات

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أجرى هذا البحث خلال موسمين زراعيين متتاليين (٢٠١٣/٢٠١٤، ٢٠١٤/٢٠١٥) بمشتل معهد بحوث البساتين، مركز البحوث الزراعية، وزارة الزراعة- الجيزة-مصربهدف دراسة تأثير تركيزات مختلفة لبعض المعاملات السمادية على النمو الخضرى وإنتاج الكورمات وبعض المحتويات الكيماوية لكريمات نبات الجلاديولس صنف روزسوبريم نظراً لأهمية النبات في تجارة الأزهارفى كل من القاهرة والأسكندرية. وقد تم زراعة الكريمات فى أصص بلاستيك مقاس ٢٥ سم تم ملؤها بنسب متساوية حجماً من الرمل والتربة الزراعية فى ٥ نوفمبر لعامى ٢٠١٣، ٢٠١٤ وبعد شهر من الزراعة تم أضافة المعاملات السماديةعلى هيئة محلول للتربة بمعدل ٣٣٣,٣ مل/نبات و لخمس مرات كل ١٥ يوم مرة وذلك بأستخدام سماد كيماوى (كريستالون) بمعدل ٢ جم/لتر وسماد عضوى (أكتوسول) بتركيز ٢,٥ أو٥ مل/لتر وسماد حيوى (مستخلص الخميرة) بمعدل ٥ أو١٠ جم/لتر وبعض التوافيق الناتجة من خلط الأسمدة السابقة لتعطى ١٣ معاملة. وقد صممت التجربة على هيئة قطع عشوائية كاملة وزرعت النباتات فى ثلاث مكررات وأربعة نباتات لكل وحدة تجريبية.

وقد أظهرت النتائج أن إضافة مستخلص الخميرة بمعدل ١٠جم/لتر مختلطا بالكريستالون بمعدل ٢جم/لتر أعطى أعلى زيادة معنوية فى كل من إرتفاع النبات، عدد الأوراق، ومحتوى الكورمات الناتجة من الكربوهيدرات الكلية بالمقارنة بالكنترول.

فى حين أدت إضافة مستخلص الخميرة بمعدل ١٠ جم/لتر مختلطا بالأكتوسول عند ٢,٥مل/لتر إلى إعطاء أكبر محيط للكورمات الناتجة (أعلى رتبة) ووزن جاف للكورمات وكذلك عدد الكريمات الناتجة / نبات بالمقارنة بالكنترول.

بجانب ذلك وجد أن إستخدام مستخلص الخميرة بمعدل ٥ جم / لتر مختلطا الأكتوسول (عند ٢,٥ أو٥ مل / لتر) أعطى أعلى وزن طازج للكورمات الناتجة وكذلك أعلى محتوى للكاروتينات الكلية فى الأوراق بالمقارنة بالكنترول.

بالإضافة الى ذلك وجد أن إستخدام الأكتوسول (عند ٢,٥ أو٥ مل / لتر) أعطى أعلى تركيز من كل من كلوروفيل ا ، ب فى الأوراق والنسبة المئوية للنتروجين فى الكورمات الناتجة وأعلى وزن طازج للكريمات الناتجة بالمقارنة بالكنترول.

من النتائج السابقة يمكن التوصية بتسميد كريمات الجلاديولس صنف "روز سوبريم"بمعدل ٣٣٣,٣ مل/نبات من مستخلص الخميرة بتركيز يتراوح من ٥ إلى ١٠ جم / لتر (أى ما يعادل ٨,٣٥ إلى ١٦,٦٦ جم / نبات / موسم) مع أكتوسول بتركيز يتراوح من٢,٥الى٥ مل/لتر (أى مايعادل ٤,١٥ إلى ٨,٣٥ مل/نبات/موسم) مع تكرار ذلك خمس مرات/نبات/موسم وذلك للحصول على كورمات بجودة عالية.