**Scientific J. Flowers & Ornamental Plants**
**www.ssfop.com/journal**
**ISSN: 2356-7864**

# EFFECT OF GROWING MEDIA, BIO AND CHEMICAL FERTILIZATION ON THE PRODUCTION OF GLADIOLUS (CV. NOVALUX) CORMS FROM CORMLETS

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**ABSTRACT:** The experimental trial was consummated during two successive seasons (2011/ 2012 and 2012/ 2013) at the nursery of Hort. Res. Inst., Giza, Egypt. It was intended to find out the solve of one of the most important problems faced the production of Gladiolus in Egypt, i.e. the deterioration of corms production year after year. So, the independent as well as the combined effects of different growing media (sand, sand/compost 1:1 v/v and sand/sewage sludge 3:1 v/v), fertilization treatments (NPK at 1:2:1, kristalon and EM 5%) and their interaction were investigated on the production of Gladiolus corms from cormlets locally. The results indicated that growing cormlets in sand/compost (1:1 v/v) medium proved its mastery in raising corms yield, corm fresh and dry weights, corm circumference and root length of corm as well as cormlets yield and quality in both seasons.

Meanwhile, using sand medium in plantation achieved the second rank in improving the same parameters in the same seasons. Results indicated also the prevalence of all corms and cormlets parameters due to applying the mixture of N, P and K, whereas kristalon and EM 5% showed less effect in this regard. Chemical constituents of the new formed corms were also affected by the previous treatments, where growing cormlets in sand/compost medium showed its superiority in raising N, P and K as well as total carbohydrates content in the new corms. Also, NPK fertilization revealed an increment on the same parameters in the same organ.

From the aforementioned results and interactions, it could be recommended to grow Gladiolus (cv. Novalux) cormlets in sand/compost medium along with treating the plants with NPK mixture at a ratio of 1: 2: 1 at the rate of 2 g/pot, 8 times at 15 day intervals to obtain high yield and quality of the new formed corms.

**Key words:** Gladiolus (cv. Novalux), growing media, EM, kristalon, NPK.

***Scientific J. Flowers & Ornamental Plants, 1(1):89-100 (2014).***

**Received:**
4/2/2014

**Revised by:**
Prof. Dr. F.S. Badran, Minia Univ.

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## INTRODUCTION

Gladiolus plant belongs to family Iridaceae and considered as one of the most important flowering bulbs grown in Egypt. Gladiolus plant probably involved about 250 species originated in the meditteranean region, tropical and South Africa and being cultivated in different countries. Flowers are funnel tube 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 the corms locally is very necessary.

Growing media are among the important parameters that play vital role on growth and development of the plant. Soil conditioner is widely utilized to compensate the limited supply of nutrients as well as increase water use efficiency (John and David, 2000). Sandy soil has poor hydrophysical properties, i.e. high rate of evaporation, porosity, lack of the organic matter, less water holding capacity and limited nutrient elements supplying. Amending the organic compost into a sandy soil proved highly beneficial effect on both soil properties and plant growth. Decomposition of the compost allows more releasing of inorganic elements in available forms to be more easily taken by the plant roots (Shanks and Gouin, 1985). Sewage sludge proved highly beneficial effect on sand and calcareous soil and has been described as the most suitable organic conditioner for the desert soil (Askar, 1988) and also as a slow release fertilizer in potting media to eliminate the need for additional fertilizer (Gouin, 1994).

Few information are available on the effect of growing media on bulb productivity of Gladiolus plant. So, the literature on other bulbs is indispensable in this concern. Nasr (2000) on tuberose plant, concluded that sand/composted leaves medium resulted in significant increase in bulbs yield and fresh and dry weights of produced bulblets. Abbass (2003) on the same plant, found that adding the sewage sludge at the high level (15%) increased leaves dry weight, number of bulbs as well as leaf content of N, P and K. Abdel-Sattar *et al.* (2010) on *Polianthes tuberosa* stated that planting in sand+compost mixture (3:1 v/v) induced a clear prevalence in producing higher quality and quantity of bulbs and bulblets, whereas planting in sand/sewage sludge (3:1 v/v) mixture led to increase the content of N, P and K, amino acids, total reduced and non-reduced sugars in the new formed bulbs. El-Sayed *et al.* (2012) on *Freesia refracta* cv. "Red Lion", concluded that growing cormlets in sand/sewage sludge medium (3:1 v/v) gave rise, to some extent corms yield, fresh weight of new corms, corms circumference and fresh weight of cormlets, besides it increased N and P% in the new corms.

Concerning the effect of chemical fertilization on the production of corms or bulbs. El-Khateeb *et al.* (1991) on *Freesia refracta* cv. Aurora reported that nitrogen alone or combined with potassium increased fresh and dry weights of corms. Badawy (1998) on *Polianthes tuberosa* repoted that all types of chemical fertilization caused an increment on bulbs yield, whereas, fresh weight of bulbs was increased due to applying kristalon at 1 g/plant and NPK at the rate of 3 g/plant. Soliman (2002) on *Iris tingitana* cv. Purple Sensation concluded that kristalon (at 1 g/plant applied five times) followed by NPK at 3 g/plant applied three times resulted in the heaviest fresh weight of bulb. El-Hanafy *et al.* (2005) added that using the commercial product of multi feed (13:3:43) caused an increment on fresh weight of corm. Meanwhile, all chemical fertilization treatments (NPK at 2 g/plant, multi feed and super feed at 1 g/plant) increased number of corms/plot (corms yield).

Amendment of soil with EM solutions, which contains selected species of microorganisms including predominant population of lactic acid bacteria and yeast and smaller numbers of photosynthetic bacteria, actinomycetes and other types of microorganisms; significantly increased efficiency all nutrients from all organic fertilizers low in C:N ratio (Piyadasa *et al.*, 1993; Millner and Kaufman, 1996; Obreza and Hampton, 2000). Concerning the effect of EM, Daly and Stewart (1999) used EM biostimulant on bean , pea and onion, reported that the EM improved the nutrient uptake efficiency, enhanced root growth and increased yield. Abd El-Messeih *et al.* (2005) indicated that EM enhanced vegetative growth, leaf chlorophylls, improved soil structure, yield and fruit quality of Le conte pear trees grown in calcareous soil. Also, El-Seginy (2006) on the same plant added that soil application of

EM gave a significant increase in vegetative growth parameters of pears (trunk circumference, number of new shoots, shoot length, shoot diameter, leaf area and tree height) as well as leaf chlorophyll readings and total carbohydrates content. Eliwa *et al.* (2009) on *Iris tingitana* cv. Wedgewood concluded that the combination of actosol at 2.5 $cm^3$/l as a foliar spray+actosol at 20 $cm^3$/l as soil drench+EM 5% as soil drench revealed a great influence on increasing fresh weight of bulblets.

Therefore, the current research aimed to solve one on the most important problems faced the production of Gladiolus (cv. Novalux) in Egypt, i.e. the deterioration of corms production year after year by using the effect of growing media, bio and chemical fertilization on the production of Gladiolus (cv. Novalux) corms from cormlets.

## MATERIALS AND METHODS

This investigation was consummated throughout two successive seasons (2011/2012 and 2012/2013) at the nursery of Hort. Res. Inst., Giza, Egypt. It was conducted to cover the independent and combined effects of different growing media {sand, sand/compost (1:1 v/v) and sand/sewage sludge (3:1 v/v)} and either bio (EM 5%) or chemical fertilization (NPK mixture and kristalon) on the production of corms from cormlets of Gladiolus cv. Novalux.

**Plant materials:**

- Locally produced cormlets of 0.7 - 0.8 cm in diameter were selected and stored at 5°C pre-planting for three months to study the effect of different growing media and fertilization treatments on the production of corms from cormlets of Gladiolus cv. Novalux.
- Different growing media of sand, sand/compost (1:1 v/v) and sand/sewage sludge (3:1 v/v) were used in the two seasons. Physical and chemical properties of the used sand, compost and sewage sludge are presented in Tables (a, b and c, respectively).

**Different fertilization treatments:**

- **EM:** Bio fertilizer contains more than 60 selected strains of effective microorganisms (Viz, photosynthetic and lactic acid (bacteria, yeast, actionmycetes and various fungi).
- **Kristalon:** (D S M Agri. Specialized by Holland) 19:19:19 of N,P and K contained 0001% Cu, 0.25% Br and Mo 1 g/l.
- **NPK:** The fertilizers used to form NPK mixture were ammonium sulphate (20.6% N), calcium superphosphate (15.5% $P_2O_5$) and potassium sulphate (48-52% $K_2O$). They were used at a ratio of 1:2:1.

**Table a. Physical and chemical properties of sand used in plantation.**

| Soil Medium | Particle size distribution % | | | | S.P | pH | E.C. $dsm^{-1}$ | Cations (meq/l) | | | | Anions (meq/l) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse Sand | Fine Sand | Clay | Silt | | | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{-}$ |
| **Sand** | 88.04 | 3.21 | 0.72 | 8.03 | 21.07 | 7.75 | 3.46 | 13.46 | 4.98 | 20.40 | 0.62 | 2.40 | 14.50 | 22.56 |

**Table b. Chemical properties of the used compost.**

| Organic additive type | Macro elements % | | | | | Micro elements (ppm) | | | | O.C. % | O.M % | C/N Ratio | pH | E.C. $dSm^1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | Ca | Mg | Zn | Fe | Mn | Cu | | | | | |
| **Compost** | 1.41 | 0.47 | 1.82 | 0.17 | 0.74 | 28.46 | 10.21 | 110 | 46 | 12.54 | 21.56 | 8.90 | 8.11 | 4.10 |

**Table c. The main characteristics of the used sewage sludge.**

| Property factors | Macro element values | | | |
|---|---|---|---|---|
| | **P** | **K** | **Mg** | **Ca** |
| **Soluble macronutrients (mg.kg$^{-1}$)** | 7.40 | 40 | 39 | 360 |
| **Total macronutrients (mg.kg$^{-1}$)** | 3150 | 2585 | 8367 | 44000 |
| | **Micro element values** | | | |
| | **Fe** | **Mn** | **Zn** | **Cu** |
| **Extractable micronutrients (mg.kg$^{-1}$ by DPTPA at pH7.3)** | 455 | 59 | 604 | 38 |
| **Total micronutrients (mg.kg$^{-1}$)** | 23031 | 413 | 2159 | 1035 |
| | **Heavy metal values** | | | |
| | **Pb** | **Ni** | **Cd** | **Co** |
| **Extractable heavy metals (mg.kg$^{-1}$ by DPTPA at pH7.3)** | 25 | 30 | 2.10 | 1.40 |
| **Total heavy metals (mg.kg$^{-1}$)** | 638.0 | 119.50 | 30.40 | 34.20 |
| | **Chemical Properties values** | | | |
| **EC(1:20 extraction) dsm$^{-1}$** | 2.10 | | | |
| **pH(1:10 suspension)** | 7.10 | | | |
| **Organic matter %** | 49.30 | | | |
| **Total nitrogen %** | 2.50 | | | |
| **Moisture content** | 7.00 | | | |
| **Bulk density(g cm$^{-3}$)** | 0.51 | | | |

## Procedure:

The cormlets were planted on October 26$^{th}$ in both seasons in 20 cm diameter plastic pots (4 cormlets/pot) filled with about 2.5 kg/pot of the above mentioned growing media used {sand, sand/compost (1:1 v/v) and sand/sewage sludge (3:1 v/v)}. The pots of every type of growing medium were redivided again into four groups for studying the effect of different fertilization treatments (Control, EM, Kristalon and NPK mixture).

## Experiment Design:

The layout of the experiment in the two seasons was a factorial experiment in randomized complete block design (RCBD) with three replicates. The first factor was the type of growing media, whereas, the second one was bio and chemical fertilization treatments. Every experimental unit contained 12 cormlets and every treatment was represented by 36 cormlets.

EM 5% biofertilizer was applied as a soil drench (100 ml/l for each pot). Meanwhile, kristalon and NPK mixture (1:2:1) were applied as a soil dressing at 2 g/pot. All fertilization treatments were applied 8 times at 15 days intervals commencing from January 15$^{th}$ to May 15$^{th}$.

Regular agriculture practices such as weeding, watering…etc were carried out whenever necessary. Every pot received about 15% of its volume fresh water in every irrigation.

## Data were registered as follows:

- Number of corms/experimental unit (corms yield).
- Corm fresh weight (g).
- Corm dry weight (g).
- Corm circumference (cm).
- Root length of corm (cm).
- No. of cormlets/experimental unit (cormlets yield).
- Fresh weight of cormlet (g).
- Dry weight of cormlet (g).

Chemical analysis of the new corms was determined in dry samples as the percentage of total carbohydrates were determined by using colorimetric method given by Smith *et al.* (1956), nitrogen (Pregel, 1945), phosphorus (Watanabe and Olsen, 1965) and potassium using flame photometer (Dewis and Freitas, 1970).

The obtained data were statistically analysed using the producers outlined by Snedecor and Cochran, (1980). The least significant differences (LSD) were used to compare the average of the determined parameters.

## RESULTS AND DISCUSSION

**Effect of growing media, bio and chemical fertilization and their interaction on corms yield and quality, Tables (1, 2 and 3)**

Marked influence on all corm parameters was detected in both seasons due to using the different growing media in plantation. In this connection, growing cormlets in sand/compost medium proved its mastery in raising corms yield, corm fresh and dry weights, corm circumference and root length of corm and occupied the first rank in this regard. Meanwhile, using sand medium in plantation achieved the second position in improving the same parameters in the two seasons. On the contrary, the least scores were obtained as a result of using sand/sewage sludge medium in plantation with significant differences comparing with that gained from the other two media used in some instances.

The prevalence of sand/compost medium in plantation for improving corm parameters might be attributed to the beneficial effect of amending the organic compost into sandy soil which improves both soil properties and plant growth. Also, decomposition of the compost allows more releasing of inorganic elements in available form to be more easily taken by the plant roots. In addition organic acids released during decomposition help more releasing of the nutrients from the mineral portion of the soil (Shanks and Gouin, 1985).

**Table 1. Effect of growing media, bio-and chemical fertilization and their interaction on No. of corms/experimental unite (corms yield) and corm fresh weight (g) of Gladiolus cv. Novalux during 2011/2012 and 2012/2013 seasons.**

| Treatments | Number of corms/experimental unite (corms yield) | | | | Corm fresh weight (g) | | | |
|---|---|---|---|---|---|---|---|---|
| | Sand | Sand + compost | Sand + sewage sludge | Mean | Sand | Sand + compost | Sand + sewage sludge | Mean |
| **1st Season** | | | | | | | | |
| **Control** | 2.00 | 2.67 | 1.33 | 2.00 | 5.43 | 8.27 | 3.50 | 5.76 |
| **Kristalon** | 2.66 | 3. 00 | 1.67 | 2.44 | 7.79 | 8.77 | 5.31 | 7.29 |
| **NPK** | 3.33 | 3.66 | 2.33 | 3.11 | 10.00 | 11.33 | 7.83 | 9.65 |
| **EM** | 3.00 | 3.33 | 2.00 | 2.78 | 9.17 | 9.37 | 6.36 | 8.30 |
| **Mean** | 2.75 | 3.17 | 1.83 | | 8.10 | 9.37 | 5.75 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = 0.76 | | | | **A** = 1.93 | | | |
| | **B** = 0.97 | | | | **B** = 2.47 | | | |
| | **A×B** = 1.69 | | | | **A×B** = 3.92 | | | |
| **2nd Season** | | | | | | | | |
| **Control** | 2.00 | 2.25 | 1.67 | 1.89 | 5.85 | 7.14 | 6.27 | 6.42 |
| **Kristalon** | 2.17 | 2.67 | 2.33 | 2.39 | 7.40 | 7.91 | 6.35 | 7.22 |
| **NPK** | 2.50 | 2.83 | 2.73 | 3.06 | 9.77 | 10.12 | 8.10 | 9.33 |
| **EM** | 2.42 | 3.00 | 2.50 | 2.67 | 7.98 | 8.57 | 7.47 | 8.00 |
| **Mean** | 2.29 | 2.87 | 2.33 | | 7.75 | 8.43 | 7.05 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = 0.65 | | | | **A** = 1.96 | | | |
| | **B** = 0.83 | | | | **B** = 2.50 | | | |
| | **A×B** = 1.57 | | | | **A×B** = 4.33 | | | |

**A= Growing media, B= Fertilization treatments**

**Table 2. Effect of growing media, bio-and chemical fertilization and their interaction on corm dry weight (g) and corm circumference of Gladiolus cv. Novalux during 2011/2012 and 2012/2013 seasons.**

| Treatments | Corm dry weight (g) | | | | Corm circumference (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | Sand | Sand + compost | Sand + sewage sludge | Mean | Sand | Sand + compost | Sand + sewage sludge | Mean |
| **1st Season** | | | | | | | | |
| **Control** | 2.55 | 3.87 | 1.59 | 2.65 | 4.00 | 4.67 | 3.33 | 4.00 |
| **Kristalon** | 3.24 | 4.15 | 2.98 | 3.46 | 5.00 | 5.13 | 4.67 | 4.89 |
| **NPK** | 5.13 | 5.58 | 4.28 | 5.11 | 6.00 | 7.33 | 6.33 | 6. 22 |
| **EM** | 4.60 | 4.65 | 3.20 | 4.15 | 5.33 | 7.28 | 5.33 | 5.33 |
| **Mean** | 3.88 | 4.55 | 3.01 | | 5.08 | 5.33 | 4.97 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = 0.99 | | | | **A** = 0.63 | | | |
| | **B** = 1.27 | | | | **B** = 0.81 | | | |
| | **A×B** = 2.09 | | | | **A×B** = N.S | | | |
| **2nd Season** | | | | | | | | |
| **Control** | 3.05 | 3.23 | 2.75 | 3.11 | 4.67 | 5.44 | 4.83 | 4.98 |
| **Kristalon** | 3.58 | 3.67 | 2.85 | 3.37 | 5.44 | 5.67 | 5.00 | 5.37 |
| **NPK** | 4.41 | 4.83 | 3.66 | 4.35 | 6.61 | 7.50 | 6.17 | 6.76 |
| **EM** | 4.06 | 4.08 | 3.25 | 3.80 | 5.83 | 7.16 | 5.83 | 6.28 |
| **Mean** | 3.77 | 3.95 | 3.12 | | 5.64 | 6.47 | 5.45 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = 0.95 | | | | **A** = 0.75 | | | |
| | **B** = 1.21 | | | | **B** = 0.96 | | | |
| | **A×B** = 1.89 | | | | **A×B** = N.S | | | |

**A= Growing media, B= Fertilization treatments**

However, the beneficial effect of sand/compost medium in improving the previous traits was confirmed by other researchers. Nasr (2000) on tuberose plant concluded that sand/compost leaves resulted in significant increase in bulbs yield. El-Fawakhry (2001) on *Polianthes tuberosa* concluded that planting the bulbs in the mixture of coarse sand+compost leaves showed its superiority in producing the tallest roots. Abdel-Sattar *et al.* (2010) on the same plant stated that planting in sand+compost mixture (3:1 v/v) produced higher quality and quantity of bulbs.

Great influence was observed on all corm parameters due to applying the mixture of N, P and K. Such treatment gave the utmost high values with significant effect comparing with control in both seasons as indicated in Tables (1 and 2). Meanwhile, the other two treatments (kristalon and EM%) also improved all corm parameters compared with control, but with less effect compared with that gained from NPK mixture. They gave means closely near together and they occupied the second rank in improving the previous traits in the two seasons.

Referring to the beneficial effect of chemical fertilization of NPK as well as kristalon and EM applications in improving the previous parameters, a lot of scientists on certain plant bulbs confirmed such results. Badawy (1998) on *Polianthes tuberosa* concluded that fresh weight of bulb was increased due to using kristalon at 1 g/plant and NPK mixture at the rate of 3 g/plant. Pandey *et al.* (2000) on *Iris douglasiana,* demonstrated that the best yield of bulbs was obtained from adding 20 g N as urea and 20 g $P_2O_5$ as superphosphate per $m^2$. Khalafalla *et al.* (2000) on *Ornithogalum thrysoides*

**Table 3. Effect of growing media, bio-and chemical fertilization and their interaction on root length of corm (cm) and No. of cormlets/experimental unite (cormlets yield) of Gladiolus cv. Novalux during 2011/2012 and 2012/2013 seasons.**

| Treatments | Root length of corm (cm) | | | | Number of cormlets/ experimental unite (cormlets yield) | | | |
|---|---|---|---|---|---|---|---|---|
| | Sand | Sand + compost | Sand + sewage sludge | Mean | Sand | Sand + compost | Sand + sewage sludge | Mean |
| **1st Season** | | | | | | | | |
| **Control** | 12.33 | 13.33 | 9.33 | 11.67 | 7.00 | 8.00 | 7.33 | 7.45 |
| **Kristalon** | 14.00 | 20.00 | 10.67 | 14.89 | 11.00 | 9.00 | 8.33 | 9.44 |
| **NPK** | 17.94 | 21.87 | 15.00 | 18.27 | 13.33 | 13.66 | 11.00 | 12.67 |
| **EM** | 14.17 | 20.67 | 12.20 | 15.68 | 8.00 | 10.67 | 8.66 | 9.11 |
| **Mean** | 14.61 | 18.97 | 11.80 | | 9.83 | 10.33 | 8.83 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = 2.78 | | | | **A** = 1.51 | | | |
| | **B** = 3.55 | | | | **B** = 1.93 | | | |
| | **A×B** = N.S | | | | **A×B** = N.S | | | |
| **2nd Season** | | | | | | | | |
| **Control** | 10.00 | 12.33 | 9.83 | 10.72 | 4.00 | 5.67 | 4.15 | 4.56 |
| **Kristalon** | 11.33 | 15.33 | 11.00 | 12.56 | 4.66 | 6.28 | 4.33 | 5.11 |
| **NPK** | 13.33 | 17.33 | 12.00 | 14.22 | 6.33 | 7.33 | 6.00 | 6.56 |
| **EM** | 12.33 | 16.33 | 11.50 | 13.39 | 6.00 | 4.00 | 5.33 | 5.11 |
| **Mean** | 11.75 | 15.33 | 11.08 | | 5.25 | 5.83 | 4.91 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = 2.03 | | | | **A** = N.S | | | |
| | **B** = 2.60 | | | | **B** = N.S | | | |
| | **A×B** = N.S | | | | **A×B** = N.S | | | |

**A= Growing media, B= Fertilization treatments**

found that the two rates of NPK fertilization (3 and 4 g/plant) significantly increased both fresh and dry weights of the produced bulbs. Soliman (2002) on *Iris tingitana* cv. "Purple Sensation" concluded that kristalon at 1 g/plant followed by NPK mixture at 3 g/plant resulted in the heaviest fresh weight of bulb.

El-Hanafy *et al.* (2005) on *Freesia refracta* cv. "Aurora" reported that using the commercial product of multi feed (13: 3: 43) caused an increment on fresh weight of corm. Meanwhile, all chemical fertilization treatments (NPK at 2 g/plant, Multi feed and Super feed at 1 g/plant) increased number of corms/plot (corms yield). Referring to the beneficial effect of EM, Daly and Stewart (1999) used EM biostimulant on bean, pea and onion, and reported that EM improved the nutrient uptake efficiency, enhanced root growth and increased the yield.

From the interactions, it could be concluded that growing cormlets in sand/compost medium with supplying the plants with NPK mixture was the best treatment in improving corms yield and corm fresh and dry weights, with significant effect in both seasons. Meanwhile, corm circumference and root length of corm were not significantly affected by the interactions in the two seasons.

**Effect of growing media, bio and chemical fertilization and their interaction on cormlets yield and quality:**

Although no significant effects were recorded on cormlets yield and quality due to using the different growing media used in plantation in most cases, it could be mentioned that sand/compost followed by sand media were the best media used in improving cormlets yield and quality in both seasons as seen in Tables (3 and 4).

**Table 4. Effect of growing media, bio-and chemical fertilization and their interaction on cormlet fresh and dry weights (g) of Gladiolus cv. Novalux during 2011/2012 and 2012/2013 seasons.**

| Treatments | Cormlet fresh weight (g) | | | | Cormlet dry weight (g) | | | |
|---|---|---|---|---|---|---|---|---|
| | Sand | Sand + compost | Sand + sewage sludge | Mean | Sand | Sand + compost | Sand + sewage sludge | Mean |
| | | | | 1st Season | | | | |
| **Control** | 1.09 | 1.27 | 1.16 | 1.17 | 0.40 | 0.38 | 0.40 | 0.39 |
| **Kristalon** | 1.27 | 1.31 | 1.25 | 1.28 | 0.52 | 0.41 | 0.43 | 0.46 |
| **NPK** | 1.58 | 1.79 | 1.35 | 1.58 | 0.69 | 0.75 | 0.60 | 0.68 |
| **EM** | 1.34 | 1.33 | 1.27 | 1.32 | 0.45 | 0.62 | 0.53 | 0.53 |
| **Mean** | 1.32 | 1.43 | 1.26 | | 0.52 | 0.54 | 0.49 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = N.S | | | | **A** = N.S | | | |
| | **B** = N.S | | | | **B** = 0.19 | | | |
| | **A×B** = N.S | | | | **A×B** = N.S | | | |
| | | | | 2nd Season | | | | |
| **Control** | 0.98 | 0.91 | 1.00 | 0.96 | 0.42 | 0.37 | 0.38 | 0.39 |
| **Kristalon** | 1.05 | 1.14 | 1.03 | 1.07 | 0.43 | 0.40 | 0.41 | 0.42 |
| **NPK** | 1.30 | 1.67 | 1.12 | 1.36 | 0.48 | 0.64 | 0.50 | 0.54 |
| **EM** | 1.19 | 1.16 | 1.07 | 1.14 | 0.45 | 0.59 | 0.43 | 0.49 |
| **Mean** | 1.13 | 1.22 | 1.05 | | 0.45 | 0.50 | 0.43 | |
| **LSD at 0.05 for** | | | | | | | | |
| | **A** = N.S | | | | **A** = N.S | | | |
| | **B** = 0.38 | | | | **B** = 0.15 | | | |
| | **A×B** = N.S | | | | **A×B** = N.S | | | |

**A= Growing media, B= Fertilization treatments**

The aforementioned results showed to some extent the beneficial effect of using sand/compost medium in plantation for improving cormlets yield and quality. In this connection, many workers confirmed such result on many plant species. Nasr (2000) on tuberose plant concluded that sand/compost leaves medium resulted in significant increase in fresh and dry weights of produced bulblets. Abdel-Sattar *et al.* (2010) on the same plant stated that planting in sand+compost mixture (3:1 v/v) produced higher quality and quantity of bulblets.

Cormlets yield and fresh and dry weights showed also an increment with significant effect comparing with control in most cases due to supplying the plants with the mixture of N, P and K in both seasons. Meanwhile, the other two fertilization treatments (kristalon and EM) revealed insignificant effect comparing with control in most cases.

Similarly, the beneficial effect of NPK mixture, in improving cormlets yield and quality was also observed by a lot of workers. Badawy (1998) on *Polianthes tuberosa* reported that chemical fertilization of NPK caused a significant increment in bulblets fresh weight. Nasr (2000) on the same plant concluded that NPK fertilization tended to increase bulblets yield and fresh and dry weights of bulblets.

The interactions, revealed insignificant effects on either cormlets yield or their quality in both seasons as indicated in Tables (3 and 4).

**Chemical constituents of the new formed corms:**

**1- N, P and K%:**

Data registered in Table (5) indicate the superiority of growing cormlets in sand/compost medium in raising N, P and

**Table 5. Effect of growing media, bio-and chemical fertilization and their interaction on N, P and K% in new formed corms of Gladiolus cv. Novalux during 2012/2013 season.**

| Treatments | N% | | | | P% | | | | K% | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Sand+ compost | Sand+ sewage sludge | Mean | Sand | Sand+ Compost | Sand+ sewage sludge | Mean | Sand | Sand+ compost | Sand+ sewage sludge | Mean |
| **Control** | 1.96 | 2.52 | 1.68 | 2.05 | 0.30 | 0.45 | 0.21 | 0.32 | 1.41 | 1.55 | 1.38 | 1.45 |
| **Kristalon** | 1.96 | 2.60 | 1.68 | 2.08 | 0.32 | 0.46 | 0.23 | 0.34 | 1.41 | 1.57 | 1.39 | 1.46 |
| **NPK** | 1.98 | 2.66 | 1.76 | 2.13 | 0.38 | 0.55 | 0.28 | 0.40 | 1.52 | 1.66 | 1.45 | 1.54 |
| **EM** | 1.97 | 2.62 | 1.68 | 2.09 | 0.33 | 0.46 | 0.25 | 0.34 | 1.42 | 1.58 | 1.39 | 1.47 |
| **Mean** | 1.97 | 2.6 | 1.70 | | 0.33 | 0.48 | 0.24 | | 1.44 | 1.59 | 1.40 | |

K% in the new formed corms. Meanwhile, growing cormlets in sand followed by sand/sewage sludge media occupied the second and third ranks, respectively in this regard.

Concerning the effect of chemical fertilization and biostimulant treatments (EM), it is evident from data scored in Table (5) that all treatments slightly increased N, P and K contents in the new corms comparing with control, where NPK mixture occupied the first rank in this regard. Meanwhile, the other two treatments (kristalon and EM) gave less lesser values.

The interactions, on the other side, indicate the prevalence of growing cormlets in sand/compost medium and treating plants with the mixture of N, P and K in raising N, P and K content in the new corms, followed by those grown in the same medium and received either kristalon or EM treatments.

**2- Total carbohydrates %:**

It is evident from data outlined in Table (6) the great influence of using sand/compost medium in plantation for raising total carbohydrates content in the new formed corms. Meanwhile, the other two growing media used occupied the second rank in improving such constituents.

NPK fertilization, on the other side, proved its mastery in elevating total carbohydrates % in the new corms. Meanwhile, the other two treatments (kristalon and EM) achieved the second position in improving the same constituents and they gave means near together.

The interactions indicated the superiority of growing cormlets in sand/compost medium and treating the plants with NPK mixture. However, growing cormlets in the same medium with supplying the plants with either kristalon or EM treatments occupied the second rank in elevating the same constituents.

As shown from the previous results the beneficial effect of sand/compost medium in improving chemical constituents of the produced corms. This result is in conformity with that obtained by El-Fawakhry (2001) on *polianthes tuberosa.*He reported that the mixture of coarse sand+fine sand+compost leaves (1:1:1 v/v/v) gave the best values for chemical composition of the produced bulbs. Also, Nasr (2000) on the same plant concluded that sand/composted leaves medium gave the highest N and P contents of the produced bulbs.

The previous results show clearly the prevalence of NPK in improving chemical constituents of the produced bulbs. In this connection, many researchers confirmed such effect. El-Khateeb (1979) stated that chemical fertilization of NPK of Gladiolus cormels cv. Eurovission increased soluble and non-soluble sugars content of the new corms. Nasr (2000) on *polianthes tuberosa* mentioned that chemical fertilization of NPK increased soluble, insoluble, total sugars, N, P and K contents. The beneficial effect of

**Table 6. Effect of growing media, bio-and chemical fertilization and their interaction on total carbohydrates % in the new formed corms of Gladiolus cv. Novalux during 2012/2013 season.**

| Treatments | Total carbohydrates | | | |
|---|---|---|---|---|
| | Sand | Sand+ compost | Sand+ sewage sludge | Mean |
| **Control** | 15.85 | 22.35 | 15.61 | 17.94 |
| **Kristalon** | 17.14 | 24.08 | 17.06 | 19.43 |
| **NPK** | 21.65 | 27.84 | 18.61 | 22.7 |
| **EM** | 17.50 | 24.25 | 18.64 | 20.13 |
| **Mean** | 18.03 | 24.63 | 17.48 | |

EM in this concern was also reported by Eliwa *et al.* (2009) on *Iris tingitana* cv. Wedgewood. They concluded that total carbohydrates content in leaves revealed clear increment due to actosol at 5 $cm^3$/l as foliar spray+actosol at 20 $cm^3$/l as soil drench+ EM 5% as soil drench. P% in leaves showed a clear increment resulting from using the combination of EM 5% as soil drench and either actosol at 10 $cm^3$/l or 20 $cm^3$/l as soil drench.

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# تأثير بيئات النمو والتسميد الكيماوي والحيوي على إنتاج كورمات الجلاديولس (صنف Novalux) من الكريمات

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أجرى البحث خلال موسمين زراعيين متتاليين (٢٠١٢/٢٠١١ و ٢٠١٣/٢٠١٢) بمشتل معهد بحوث البساتين بالجيزة، مصر بهدف الوصول إلى حل لمشكلة من أهم المشاكل التي تواجه إنتاج الجلاديولس في مصر ألا وهى التدهور في إنتاج كورمات الجلاديولس محلياً سنه تلو الأخرى. وعلى هذا صمم البحث لتدارس تأثير العوامل المنفردة وكذا المتجمعة لتأثير بيئات نمو مختلفة (رمل خالص، رمل+ كمبوست (١:١حجماً) و رمل+ حمأة (١:٣ حجماً) ومعاملات تسميد مختلفة (مخلوط النتروجين والفوسفوروالبوتاسيوم١:٢:١ والمستحضر التجاري كريستالون ومركب الـ EM بمعدل ٥%) على إنتاج الكورمات من الكريمات محلياً.

وقد أوضحت النتائج التفوق الواضح من زراعة الكريمات في بيئة مخلوط الرمل+الكمبوست (١:١ حجماً) في زيادة محصول الكورمات الناتجة، الوزن الطازج والجاف للكورمات وكذا محيطها بالإضافة إلى زيادة طول الجذور للكورمات الجديدة المتكونة، كذلك أظهرت النتائج تفوق نفس البيئة في زيادة محصول الكورمات الناتجة وصفاتها الناتجة في كلا الموسمين. في نفس الوقت حقق إستخدام بيئة الرمل الدرجة الثانية بالنسبة لتحسين نفس الصفات السابقة في كلا الموسمين أيضاً. هذا وقد أكدت النتائج أيضاً التفوق الواضح في كافة صفات الكورمات والكريمات الناتجة نتيجة لاستخدام مخلوط النتروجين والفوسفور والبوتاسيوم بنسبة ١:٢:١، بينما أظهر إستخدام المستحضر التجاري كريستالون و الـ EM ٥% تأثير أقل بالنسبة للتأثير على الصفات السابقة. وأوضحت التحليلات الكيماوية بالنسبة للكورمات الجديدة الناتجة تأثراً واضحاً بالمعاملات السابقة حيث أدى إستخدام بيئة مخلوط الرمل+ الكمبوست (١:١ حجماً) تميزاً واضحاً في زيادة محتوى الكورمات الجديدة الناتجة من النتروجين والفوسفوروالبوتاسيوم١:٢:١والكربوهيدرات الكلية وفي نفس الوقت تم الحصول على نفس التأثير المتميز بالنسبة للمحتوى الكيماوي كنتيجة لمعاملة النباتات بمخلوط النتروجين و الفوسفور و البوتاسيوم.

من النتائج السابقة والتفاعلات بين العوامل يمكن النصح بنمو كريمات الجلاديولس فى بيئة مخلوط الرمل+ الكمبوست (١:١ حجماً) مع معاملة النباتات بمخلوط النتروجين والفوسفور والبوتاسيوم بنسبة ١:٢:١ (بمعدل ٢جرام/نبات) في كل معاملة تسميدية ثماني مرات على فترات كل ١٥ يوم للحصول على محصول جيد ووافر من الكورمات الجديدة الناتجة.