Journal of Horticultural Science & Ornamental Plants 4 (1): 89-97, 2012
ISSN 2079-2158

Raising *Freesia refracta* cv. Red Lion Corms from Cormels in Response to Different Growing Media and Actosol Levels

[1]A. El-Sayed, [1]El-Hanafy H. Safia, [2]A. Nabih and [2]D.I. Atowa

[1]Department of Ornamental Horticulture, Faculty of Agriculture, Cairo University, Giza, Egypt
[2]Horticulture Research Institute, ARC, Giza, Egypt

Abstract: The experimental trial was consummated throughout two successive seasons (2009/2010 and 2010/2011) at the nursery of Horticulture Research Institute, Giza. It intended to find out the possibility of raising new corms from cormels of *Freesia refracta* cv. Red Lion under local condition. Thus, the individual and the combined effects of different growing media (clay, sand/clay (1:1,v/v) and sand/sewage sludge (3:1,v/v) and different Actosol levels (0, 2.5 and 5cm^3/l) applied as soil drench five times at 15 days intervals commencing from December 15th till February 13th on vegetative growth and corms and cormels productivity as well as chemical constituents of leaves and new corms of plants produced from cormels (1-2cm circumference) were investigated.The results emphasized that growing cormels in sand/sewage sludge medium proved its mastery in producing the highest vegetative growth and gave rise to some extent corms yield, fresh weight of new corms, corms circumference and fresh weight of cormels, besides it increased N and P% in new corms. Meanwhile, total carbohydrates in new corms was increased due to using sand/clay medium in plantation. Beneficial effects were recorded on vegetative growth height and corms and cormels productivity due to applying Actosol at 2.5cm^3/l. Moreover it slightly increased K% and P% in new corms. Meanwhile, using the highest Actosol level (5cm^3/l) was the best for elevating N% in new corms. The interactions, indicated the superiority of growing cormels in sand/sewage sludge with applying Actosol at 2.5cm^3/l for improving vegetative growth and corms and cormels productivity. Meanwhile, treating plants grown in either clay or sand/clay with applying Actosol at either 2.5 or 5cm^3/l were the best treatments in most cases for improving chemical constituents of new corms.

Key words: *Freesia refracta* · Growing media · Actosol

INTRODUCTION

Freesia (Family, Iridaceae) is grown mainly for cut flowers production. It is a popular winter flowering plant, especially after the introduction of new species and the establishment of many hybrids of a wide range of colors freesia faces yield decline and deterioration in flower quality as well as corms and cormels production yearly.

Newly reclaimed soils are potential for horizontal expansion and increasing the agricultural production in Egypt. Soil fertility means the soil capacity to supply the plants with their requirements from nutrients, water and air along the growth season [1]. 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. Researches are interested in improving the physical statues of soils under reclamation in order to solve the problem of the poor soil and obtain satisfactory plant growth. Soil conditioners are widely utilized to compensate the limited supply of nutrients as well as increase water use efficiency [2].

So, it could be concluded that growing media and fertilizer treatments are from paramount importance and play a vital role on growth and development of the plant. However little information is available for the effect of growing media and fertilization on growth and development of freesia plant. So, the literature on other corms or bulbs is indispensable in this concern. Arafa *et al*. [3] claimed that sand medium, enriched with chemical fertilization of NPK (15g/plant applied in five equal portions) revealed favorable effects on corms and

Corresponding Author: A. El-Sayed, Department of Ornamental Horticulture, Faculty of Agriculture, Cairo University, Giza, Egypt.

cormels productivity. Badawy [4] on *Polianthes tuberosa*, stated that clayey medium gave undesiratle effects on most plant parameters. Also, Abdel-Sattar *et al*. [5] on the same plant found that the least scores of plant traits were obtained resulting from using clayey medium in plantation.

Among organic residues sewage sludge proved highly beneficial effects on sandy calcareous soils and has been described as the most suitable organic conditioner for the desert soil [1] and also as a slow release fertilizer in potting media to eliminate the need for additional fertilizers [6]. In this connection, Abdel-Sattar *et al*. [5] reported that sand/sewage sludge (3:1, v/v) medium led to increase the content of N, P, K, amino acids and total reduced and non reduced sugars in the new formed bulbs.

Using actosol containing humic acid seems to be valuable in correcting the widespread occurrence of certain nutrient deficiency symptoms. This is attainted through increasing the soil water holding capacity, promoting soil structure and enhances the metabolic activity of microorganisms. They also act as a source of nitrogen, phosphorus and sulfer for plants [7, 8]. Moreover, Stevenson [9] concluded that humic substances isolacted from different materials contained 45-65% carbon, 30-48% oxygen, 2-6% nitrogen and about 5% hydrogen. Humic substances (HS) are extremely important soil components because they constitute a stable fraction of carbon (C), thus regulating the carbon cycle and release of nutrients including nitrogen (N), phosporus (P) and sulphur (S). Additionally, the presence of HS improves pH buffering and thermal insulation. El-Sayed and El-Shal [10] on Schefflera (*Brassaia actinophylla*), mentioned that humic acid treatments revealed significant effect on plant parameter, which reached its maximum due to use of Actosol (humic acid) as foliage spray plus soil drench (5.0 cm^3/l foliage spray + 10 cm^3/l soil drench). Recently, Eliwa *et al*. [11] on *Iris tingitana* cv. Wedgewood declared that supplying the plant with Actosol (Acto.) at the rate of 2.5 cm^3/l was the best treatment for increasing plant height and number of leaves/plant.

Therefore, the present experiment was conducted to study the individual and the combined effects of different growing medium [clay, sand/clay (1:1, v/v) and sand/sewage sludge (3:1, v/v)] and Actosol levels on *Freesia refracta* cv. Red Lion for achieving the hope of raising freesia corms from cormels, besides planting such plant under newly reclaimed desert land.

MATERIAL AND METHODS

The present experiment was conducted throughout two succesive seasons (2009 / 2010 and 2010 / 2011) at the nursery of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. The second season was an extact reptition of the first one. It aimed to study the individual and the combined effects of different growing media and Actosol (humic acid) levels for raising *Freesia refracta* cv. Red Lion corms from cormels.

Locally produced cormels of 1-2 cm circumference of an average weight 0.50-1 g were selected to study the effect of different growing media and Actosol treatments. Actosol is a commercial liquid organic fertilizer containing a minimum of 2.9% humic acid and 0.5% for each of Fe,Zn,Mn and Cu. Main characteristics of the used liquid active fertilizer (Actosol) is presented in Table 1. Different growing media were clay, sand / sewage sludge (3: 1, v/v) and sand/clay (1: 1, v/v).Physical and chemical properties of the growing media are exhibited in Tables 2 and 3.

In both seasons, the cormels (two cormels per pot) were planted on September 28th in 20 cm clay pots filled with 2.5kg of every growing medium used. The pots were arranged in factorial experiment in randomized complete block design (RCBD) with three replicates. The main factor represented type of growing medium, whereas sub factor exhibited Actosol treatments. Every experimental unite contained six cormels and every treatment contained 18 cormels. Actosol was applied as a soil drench (200 cm^3 each pot) 5 times commencing from December 15th till Febraury 10th at two levels (2.5 and 5 cm^3/l / pot) besides untreated plants (control). Thus, nine treatments were carried out in the two seasons (three growing media x3 Actosol treatments).

Regular agricultural practices such as watering, weeding ……etc were carried out whenever needed. Foliar application of Kristalon at 1 g/L was applied three times commencing from (November 15th) at monthly intervals as a regular care in both seasons.

The Following Data Were Recorded:

I Vegetative growth:

- Vegetative growth height at flowering time referred to as plant height (cm) and number of leaves / plant at flowering stage.

Table 1: Main characteristics of the used liquid active fertilizer (Actosol)

Components	Values	Components	Values	Components	Values
Humic acid (%)	2.9	EC (ds/m)	59.0	B (mg/l)	70.0
Organic matter / total solid (%)	42.51	N (%)	10.00	Fe (mg/l)	900.00
Total HA / total solid (%)	168.80	P (%)	10.00	Mn (mg/l)	90.00
Organic carbon (%)	24.64	K (%)	10.00	Zn (mg/l)	90.00
C / N ratio	2.46	Ca (%)	0.06		
pH	8.10	Mg (%)	0.05		

Table 2: Chemical properties of sand and sewage sludge (3:1 v/v), sand and clay (1:1v/v) and clay used in plantation according to Reclamation and Development Center for Desert Soil, Faculty of Agriculture, Cairo University

			Anion (meq/l)			Cation (meq/l)			
Soil texture	pH	EC Mmhos/cm	HCO^{3-}	CL^{-}	SO_4^{--}	Na^{+}	K^{++}	Ca^{+}	Mg^{++}
Sand and sewage sludge	7.63	2.80	1.0	10.4	21.20	6.28	0.72	17.0	8.6
Sand and clay	7.25	5.17	2.8	4.85	1.16	29.20	0.21	18.4	14.6
clay	7.56	1.25	0.5	2.5	1.29	3.55	0.89	7.3	4.2

Table 3: The main chemical characteristics of the used sewage sludge

EC (1:20) dsm^{-1}		pH (1:10)	Organic matter (%)	Total N (%)	Moisture content (%)	Bulk density $g.cm^{-3}$	
2.10		7.10	49.30	2.50	7.00	0.51	
Soluble macronutrients ($mg.kg^{-1}$)				Total macronutrients ($mg.kg^{-1}$)			
P	K	Mg	Ca	P	K	Mg	Ca
7.40	40	39	360	3150	2585	8367	44000
Extractable micronutrients ($mg.kg^{-1}$ by DPTPA at PH 7.3)				Total micronutrients ($mg.kg^{-1}$)			
Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
455	59	604	38	2303	1413	2159	1035
Extractable heavy metals ($mg.kg^{-1}$ by DPTPA at pH 7.3)				Total heavy metals ($mg.kg^{-1}$)			
Pb	Ni	Cd	Co	Pb	Ni	Cd	Co
25	30	2.10	1.40	638.0	119.5	30.40	34.20

Corms and Cormels Productivity:

- Number of the produced corms / plot (corms yield), corm fresh weight (g), corm circumference (cm), number of the produced cormels / plot (cormels yield) and cormel fresh weight (g)

These data were statistically analyzed using SAS [12] computer program and means were compared by L.S.D method according to Snedecor and Cochran [13], for detecting significancy among the means of various treatments.

Chemical Analysis: The following determinations were carried out in both seasons.

Total Carbohydrates Content in New Corms: Total carbohydrate content in new corms and leaves was determined by using colorimetric method described by Smith *et al*. [14].

Nitrogen, Phosphorus and Potassium in New Corms: Nitrogen content was determind by micro-kjeldahl apparatus [15], phosphorus content was colorimetrically determined by digestion in ascorbic acid [16], Potassium content was determined by using the flamephotometer [17].

RESULTS AND DISCUSSION

Effect on Vegetative Growth: Data registered in Table 4 reveal the superiority of growing cormels in sand/sewage sludge medium for elevating vegetative growth height at flowering time. Meanwhile, sand/clay medium occupied the second rank in elevating such parameter in the first season. In contrast, lowest records were concomitant to cormels grown in clay medium. Number of leaves/plant, on the other side, was not significantly affected by the different growing media used in both seasons. In this connection the prevalence of sand/sewage sludge in elevating vegetative growth height was also found by

Table 4: Effect of different growing media, Actosol levels and their interaction on vegetative growth height (cm.) and number of leaves/plant of *Freesia refracta* cv. Red lion throughout 2009/2010 and 2010/2011 seasons

	Vegetative growth height				Number of leaves / plant			
	Media				Media			
Actosol levels	Clay	Sand and clay	Sand and sewage sludge	Mean	Clay	Sand and clay	Sand and Sewage sludge	Mean
				1st season				
Control	21.73	27.33	24.30	24.28	7.67	7.50	8.33	7.83
2.5 cm^3/l	27.67	25.00	30.00	26.27	9.10	7.50	8.93	8.51
5 cm^3/l	21.83	21.00	26.16	24.47	8.75	7.33	8.17	8.08
Mean	23.74	24.44	26.83		8.50	7.44	8.47	
LSD at 0.05 for growing media (A) = 1.047					A = N.S			
LSD at 0.05 for Actosol fertilizer (B)= 1.047					B = N.S			
LSD at 0.05 for interaction (A×B) = 1.814					A×B = N.S			
				2nd season				
Control	21.83	24.17	22.17	22.72	6.83	6.50	7.17	6.83
2.5 cm^3/l	24.67	24.33	25.00	24.67	7.33	7.33	7.67	7.33
5 cm^3/l	23.83	21.67	24.27	23.24	6.90	6.83	7.33	7.02
Mean	23.44	23.39	23.80		6.91	6.88	7.33	
LSD at 0.05 for growing media (A) = 1.563					A = N.S			
LSD at 0.05 for Actosol fertilizer (B)= 1.563					B = N.S			
LSD at 0.05 for interaction (A×B) = 1.707					A×B = N.S			

Table 5: Effect of different growing media, Actosol levels and their interactions on Numberof the produced corms / plot, corm fresh weight (g) and corm circumference (cm) during 2009/2010 and 2010/2011seasons

	Number of the produced corms / plot				Corm fresh weight (g.)				Corm circumference (cm.)			
	Media				Media				Media			
Actosol levels	Clay	Sand &clay	Sand & sewage sludge	Mean	Clay	Sand &clay	Sand & sewage sludge	Mean	Clay	Sand &clay	Sand & sewage sludge	Mean
					1st season							
Control	5.33	4.00	7.33	5.55	2.77	2.10	3.00	2.62	5.33	4.00	5.90	5.08
2.5 cm^3/l	7.67	6.67	8.00	7.44	3.13	3.57	4.17	3.62	5.60	5.50	6.37	5.82
5 cm^3/l	6.00	3.33	7.67	5.60	2.96	2.00	4.00	3.00	5.77	4.33	6.30	5.47
Mean	6.30	4.67	7.67		2.96	2.55	3.72		5.57	4.61	6.19	
LSD at 0.05 for growing media (A) = 1.375					A = N.S				A = N.S			
LSD at 0.05 for Actosol fertilizer (B) = 1.375					B = N.S				B = N.S			
LSD at 0.05 for interaction (A×B) = 2.382					A×B = N.S				A×B = N.S			
					2nd season							
Control	5.67	5.00	7.00	5.89	2.07	2.26	2.25	2.20	3.50	3.00	3.90	3.48
2.5 cm^3/l	7.00	6.33	7.33	6.90	2.52	2.35	2.53	2.47	4.00	4.50	5.00	4.50
5 cm^3/l	6.67	5.33	6.67	6.22	2.35	2.34	2.25	2.31	3.00	3.80	4.00	3.64
Mean	6.44	5.56	7.00		2.31	2.32	2.34		3.50	3.69	4.26	
LSD at 0.05 for growing media (A) = 0.918					A = N.S				A = N.S			
LSD at 0.05 for Actosol fertilizer (B) = 0.918					B = N.S				B = N.S			
LSD at 0.05 for interaction (A×B) = 1.590					A×B = N.S				A×B = N.S			

Table 6: Effect of different growing media, Actosol levels and their interaction on number of the produced cormels / plot and cormel fresh weight (g) of *Freesia refracta* cv. Red lion throughout 2009/2010 and 2010/2011 seasons

	No. of the produced cormels / plot				Cormel fresh weight (g)			
	Media				Media			
Actosol levels	Clay	Sand &clay	Sand & sewage sludge	Mean	Clay	Sand &clay	Sand & sewage sludge	Mean
				1st season				
Control	6.67	4.00	5.04	5.22	0.25	0.24	0.21	0.23
2.5 cm^3/l	7.67	6.67	6.50	6.94	0.28	0.41	0.52	0.38
5 cm^3/l	5.00	4.00	4.67	5.86	0.30	0.33	0.38	0.34
Mean	6.44	6.29	5.94		0.27	0.33	0.37	
LSD at 0.05 for growing media (A) = N.S					A = N.S			
LSD at 0.05 for Actosol fertilizer (B) = N.S					B = N.S			
LSD at 0.05 for interaction (A×B) = N.S					A×B = N.S			
				2nd season				
Control	4.00	4.33	4.70	4.33	0.17	0.24	0.26	0.22
2.5 cm^3/l	5.70	5.00	5.60	4.88	0.28	0.23	0.38	0.25
5 cm^3/l	4.33	4.67	5.00	4.67	0.20	0.22	0.37	0.24
Mean	4.70	4.66	5.11		0.23	0.23	0.34	
LSD at 0.05 for growing media (A) = N.S					A = N.S			
LSD at 0.05 for Actosol fertilizer (B) = N.S					B = N.S			
LSD at 0.05 for interaction (A×B) = N.S					A×B = N.S			

Abdel-Sattar *et al*. [5] on *Polianthes tuberosa*. Meanwhile, the favourable effect of using sand/clay medium in plantation was also recorded by Nasr [18] on the above mentioned plant. In addition, worst result of clay medium on such trait was also obtained by Badawy [4] and El-Fawakhry [19] on Polianthes tuberosa. In this connection Askar [1] reported that sewage sludge proved highly beneficial effect on sand and calcareous soils and has been described as the most suitable organic conditioner for the desert soil.

Treating cormels with Actosol at 2.5 cm^3/l was the best for increasing vegetative growth height in both seasons. Meanwhile the second position for elevating such trait was assigned with cormels treated with the highest Actosol level (5cm^3/l). In contrast, least scores were confined to untreated cormels in both seasons. However, the great influence of Actosol in raising such parameter was also found by a lot of scientists [10, 11, 20, 21]. Number of leaves/plant, on the other hand, was not significantly affected by the different Actosol levels used in both seasons. The interactions, revealed the prevalence of growing cormels in sand/sewage sludge with applying Actosol at 2.5 cm^3/l for raising vegetative growth height at flowering time as it gave the utmost high values in both seasons. On the contrary, undesirable effects were recorded on such trait due to cormels planted in clay medium untreated with Actosol or those planted in sand/clay medium and received the highest Actosol level (5 cm^3/l). Insignificant effects, on the other side, were noticed due to the interactions between the different growing media and Actosol levels on number of leaves/plant in both seasons as indicated in Table 4.

Effect on Corms and Cormels Productivity (Tables 5and 6): It is evident from data outlined in Table 5 that growing plants in sand/sewage sludge medium gave rise to the highest number of corms/plot (corms yield) in both seasons. Meanwhile, corm circumference and fresh weight of corm were not significantly affected by the different growing media used. However, the increment on corms yield due to growing plants in sand/sewage sludge is in conformity with Abass [22] and Abdel-Sattar *et al*. [5] on *Polianthes tuberosa*.

On the other hand, number of cormels/plot (cormels yield) was not significantly affected by the various growing media used. Meanwhile, sand/sewage sludge medium insignificantly increased fresh weight of cormels.

Beneficial effects were detected on number of corms/plot (corms yield) due to applying Actosol at 2.5cm^3/l as it significantly increased corms yield compared to control in both seasons. Meanwhile, plants treated with the highest Actosol level (5cm^3/l) achieved the second

Table 7: Effect of different growing media, Actosol levels and their interaction on total Carbohydrate, N%, P% and K% in the new corms during 2009/2010 and 2010/2011 seasons

	Total Carbohydrate				N%			
	Media				Media			
Actosol levels	Clay	Sand &clay	Sand & sewage sludge	Mean	Clay	Sand &clay	Sand & sewage sludge	Mean
				1st season				
Control	58.368	70.861	62.138	63.789	4.840	3.723	5.585	4.716
2.5 cm^3/l	45.041	54.525	43.136	47.567	4.096	3.723	4.840	4.220
5 cm^3/l	43.165	45.624	53.468	41.419	5.585	4.840	4.840	5.088
Mean	48.858	57.00	52.914		4.840	4.095	5.088	
				2nd season				
Control	64.479	66.162	54.763	61.800	6.330	3.723	7.076	5.710
2.5 cm^3/l	55.127	61.035	44.456	53.539	5.585	4.023	5.840	5.149
5 cm^3/l	48.367	49.076	46.474	47.972	7.074	4.840	6.330	6.081
Mean	55.991	58.733	51.898		5.330	4.195	6.415	
P%					K%			
				1st season				
Control	3.674	3.018	3.518	3.400	2.75	2.62	2.52	2.70
2.5 cm^3/l	3.978	4.814	5.664	4.819	2.80	2.60	2.19	2.53
5 cm^3/l	2.305	3.386	4.237	3.310	2.94	2.52	2.47	2.64
Mean	3.319	3.740	4.473		2.83	2.55	2.39	
				2nd season				
Control	3.963	2.011	2.822	2.932	2.800	2.70	2.88	2.793
2.5 cm^3/l	4.910	2.828	3.300	3.679	2.880	2.66	2.30	2.613
5 cm^3/l	2.723	2.685	2.106	2.505	3.030	2.60	2.70	2.770
Mean	3.865	2.508	4.743		2.903	2.65	2.59	

position for raising such trait in both seasons. Fresh weight and circumference of new corms were not significantly affected by treating plants with different Actosol levels in both seasons.

Similary, number of cormels/plot (cormels yield) as well as fresh weight of cormels were not significantly affected by the different Actosol levels used in the two season. However, it could be concluded from data given in Table 6 that applying Actosol at 2.5cm^3/l was the best treatment for elevating the scored values of either cormels yield or fresh weight of cormels in both seasons. In this connection, the beneficial effect of Actosol treatment in raising cormels yield and fresh weight of cormels is in accordance with the finding of Eliwa *et al*. [11] on *Iris tingitana* cv. Wedgewood. She concluded that applying Actosol at 10cm^3/l as soil drench revealed its superiority for increasing bulblets yield and fresh weight of bulblet. Likewise, El-Sayed *et al* [21] on two gladiolus cvs (White and Rose prosperity) found that soaking the corms before planting in Actosol solution (a humic acid and NPK (10:10:10) liquid organic fertilizer) at the rate of 20 cm^3/l for 0,12 and 24 hours led to increase number of cormels/plant.

The interactions, on the other hand, revealed the favourable of combined effect between either sand/sewage sludge or clay media and Actosol treatment at 2.5cm^3/l for raising corms yield in both seasons. Meawhile, the same treatment insignificantly increased corm circumference and its fresh weight. Moreover, the last effect on such treatment was also observed for cormels yield and fresh weight of cormels.

Total Carbohydrate Content in New Corms: Data presented in Table 7 show clearly that sand/clay medium proved its mastery in raising total carbohydrate accumulation in new corms than that was obtained from other media used. The second position for raising such constituent was occupied by plants grown in sand/sewage sludge in the first season and those grown in clay medium in the second one.

Using the different Actosol levels, on the other side, caused a decrement in total carbohydrate content in corms in both seasons. Least scores were gained in this concern resulting from applying the highest Actosol level (5cm^3/l) as seen in Table 7.

As for the interactions, it is evident from data tabulated in Table 7 the increment in total carbohydrate accumulation in the new corms due to plants grown in sand/clay medium untreated with Actosol. In contrast, least scores on such constituent was observed as a result of plants grown in clay medium and treated with the highest Actosol level (5cm^3/l) or those grown in sand/sewage sludge and received Actosol at 2.5cm^3/l in the first season as well as those grown in sand/sewage sludge and treated with Actosol at either 2.5 or 5cm^3/l in the second one.

Minerals Content (N,P and K) in the New Corms: Considerable variations were detected in nitrogen, phosphorus and potassium accumulation in the new corms in response to the different growing media used as indicated in Table 7. Sand/sewage sludge proved its superiority in raising nitrogen content in the new corms in both seasons. The second and third ranks were occupied in such constituent due to growing plants in clay and sand /clay media, respectively. In this respect, Abdel-sattar *et al*. [5] on *Polianthes tuberosa* concluded that the mixture of sand/sewage sludge (3:1,v/v) recorded the highest content of nitrogen in the new bulbs. Likewise phosphorus content in new corms, showed the prevalence of using sand/sewage sludge in plantation in both seasons. Meanwhile, sand/clay medium in the first season and clay in the second one occupied the second rank in raising the same constituent. Potassium accumulation, on the other hand, revealed an increment due to using clay medium in cultivation, in both seasons. Meanwhile, the other media occupied the second position for raising the same constituent in the new corms. In this connection, the prevalence of clay medium in raising potassium content in new corms was also noticed by Nasr [18] on *Polianthes tuberosa* bulbs.

On the other side, the highest Actosol level (5cm^3/l) gave rise to the highest values of N% in new corms in both seasons. Meanwhile, the second rank was occupied by untreated plants with Actosol. The other Actosol level (2.5cm^3/l) recorded the least scores in this concern. However, Essa [23, 24] on cansion apricot and Kelsey plum trees, respectively) and Atef [25] on leconte pear and canion apricot trees grown in sandy soil concluded that using the organic liquid fertilizer (contain a minimum of 2.9% humic acid) increased leaf mineral content. Abdel-Fattah *et al*. [20] on Tifway Bermudagrass hybrid (*Cynodon dactylon* × *C. transvaalensis*) reported that using H.A at 10 and 20ml/l as a soil drench progressively increased the percentage of nitrogen in the new leaves. El-Sayed and El-Shal [10] on Schefflera (*Brassia actinophylla*) reported that humic acid treatment (5cm^3/l as spray + 10cm^3/l as soil drench) recorded the highest value of nitrogen in leaves. Also, Eliwa *et al*. [11] on *Iris tingitana* cv. Wedgewood stated that great effect was detected on nitrogen% in leaves as a result of applying Actosol at 2.5 cm^3/l as foliar spray.

Applying Actosol at 2.5cm^3/l resulted in the highest records in phosphorus accumulation in new corms in both seasons. Meanwhile, untreated plants with Actosol or those received the highest Actosol level (5cm^3/l) achieved the second and third positions, respectively.

On the other hand, untreated plants or those treated with the highest Actosol level (5cm^3/l) slightly increased potassium accumulation in the new corms comparing with that gained from plants treated with Actosol at 2.5cm^3/l in both seasons.

In this regard, the prevalence of Actosol for raising P and K content was ascertained by a lot of workers on different plant species Essa [23, 24] on cansion apricot and Kelsey plum trees, Hunter and Anderos [26] and Hunter and Butler [27] on *Agrostis stolonifera*, Abdel-Fattah *et al*. [20] on Tifway Bermudagrass hybrid (*Cynodon dactylon* × *C. transvaalensis*), El-Sayed and El-Shal [10] on Schefflera (*Brassia actinophylla*) and Eliwa *et al*. [11] on *Iris tingitana* cv. Wedgewood.

The interaction, on the other side, indicated that nitrogen, phosphorus and potassium accumulation in the new corms considerably varied in their response to the different treatments were applied. Data outlined in Table 7 show that applying the highest Actosol level (5cm^3/l) for plants grown in clay medium or growing plants in sand/sewage sludge without Actosol application were the best treaments for raising N% in the new corms in both seasons. Moreover, Data in the same Table reveal that plants grown in sand/sewage sludge and treated with Actosol at 2.5cm^3/l or those grown in sand/clay medium and received the same level (2.5cm^3/l) were the best treatments for raising P% in new corms in the first season. Meantime, plants grown in clay medium untreated with Actosol or those grown in the same medium and received Actosol at 2.5cm^3/l gave rise in phosphorus accumulation in the new corms in the second one.

In the matter of potassium content, it could be concluded from data averaged in Table 7 that plants grown in clay medium untreated with Actosol or treated with the two levels (2.5 and 5cm^3/l) succeeded to increase potassium accumulation in the new corms comparing with that gained from the other treatments used in both seasons.

REFERENCES

1. Askar, F.A., 1988. Stability of soil conditioners for desert and cultivated soil in Egypt . Inter. Symp. Soil Conditioners, Egypt. pp: 133-142.
2. John, S.H. and A.W. David, 2000. Soil conditioner.North Center Resgional Extension Publication, pp: 295.
3. Arafa, N. M., A. Nabih and G. A. Ibrahim, 1996. *Freesia refracta* cv. Aurora production and quality as influenced by some factors. Corms and cormels yield and quality produced from plants raised in different growing media, treated with different types of chemical fertilization. Egypt. J. Appl. Sc., 11: 139-161.
4. Badawy, O.E.F., 1998. Physiological and anatomical studies on tuberose bulbs Ph. D. Thesis. Fac. Agric., Cairo Univ. Egypt.
5. Abdel-Sattar, M.M., S.S. Ahmed and A. Nabih, 2010. Response of tuberose (*Polianthes tuberosa*, L) plant to different soil mixtures and Ethephon under reclaimed desert soil. Egypt. J. Biotechnol., 35: 185-206.
6. Gouin, F.R., 1994. Utilization of sewage sludge compost in horticulture. Hort. Abst., 64: 3281.
7. Petrovic, P., D. Vitorovic and M. Jablinovic, 1982. Investigation of biological effects of humic acids. Acta Biol. Med. Exp., 7: 21-25.
8. Higa, T. and G.N. Wididana, 1991. Change in the soil microflora induced by effective micro organisms. In : Parr, J. F., S.B. Homick and C.E. Whitman (eds.) Proceedings of the first International Conference of Kyusei Nature Farming,USA, pp: 153-162.
9. Stevenson, F.J., 1994. Humus Chemistry: Genesis, Composition, Reaction. John Wiley and Sons Inc., 2nd Ed., New York.
10. El-Sayed, B.A. and S.A. El-Shal, 2008. Effect of growing media and humic acid on Schefflera (*Brassaia actinophylla*). J. Agric. Sci. Mansoura Univ., 33: 371-381.
11. Eliwa, N.Y., B.B. Rezk Alla and M.A. El-Shamy, 2009. Effect of organic and biofertilizer treatments on growth, flowering, bulbs production and chemical constituents of *Iris tingitana* cv. Wedgewood. J. Biol. Chem. Environ. Sci., 4: 441-461.
12. SAS program, 1994. SASISTAT User´s Guide; Statistics. Vers. 6. 04, SAS Institute Inc.,4th Ed., Cary. N. C., U.S.A.
13. Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods Iowa State Univ. Press, sixth edition, Ames, Iowa, U.S.A.
14. Smith, E., M.A. Gilles, D.K. Hamitton and P.A. Gedees, 1956. Colorimetric method for determination of sugars and related substances. Ann. Chem., 28: 350.
15. Black, C.A., 1965. Methods of soil Analysis. Part I and II. Amer. Soc. Agron. Madison, U.S.A.
16. John, M.K., 1970. Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid. Soil. Sci., 109: 214-220.
17. Dewis, J. and F. Freitas, 1970. Physical and chemical methods of soil and water analysis. Food and Agric. Organization of the United Nations of Soils Bulletin, pp: 10.
18. Nasr, A.M., 2001. Effect of some factors on growth, flowering and chemical composition of *Polianthes tuberose*, L. plant. Ph. D. Thesis, Fac. Agric. Cairo Univ., Egypt.
19. El-Fawakhry, F.M., 2001. Studies on some factors affecting growth,flowering and bulbs productivity of *Polianthes tuberosa*, L. plant. Ph. D. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta Univ., Egypt.
20. Abdel-Fattah, G.H., B.A. El-Sayed and S.M. Shahin, 2008. The role of humic acid in reducing the harmful effect of irrigation with saline water on Tifway turf. J. Biol. Chem. Environ. Sci., 3: 75-89.
21. El-Sayed, B., A.A.M. Abdel-Monien and S.M. Shahin, 2010. Improving efficiency of NPK fertilizer for Spathiphyllum plant using active dry yeast at various levels. J. Bio. Chem. and Environ. Sci., 5: 1-12.
22. Abass, R.A., 2003. Response of *Polianthes tuberose*, L. to sewage sludge addition to the newly reclaimed soils. Alex. Sci. Exch., 24: 283-297.
23. Essa, F.M., 2003. Effect of some biostimulant on vegetative growth, yield and fruit quality of "Kelsey" plum. Egypt. J. Appl. Sci., 18: 716-735.
24. Essa, F.M., 2002. Use of biostimulant in activation of soil micro flora for yield and fruit quality improvement of " Canion " Apricot. Agric. Res., Tanta Unvi., 28: 354-364.
25. Atef, M.H., A.T. El-Maghraby, H.M. Sherif and S.A. El-Shal, 2005. Effect of liquid organic fertilization techniques on yield and chemical composition of pear and apricot trees grown on sandy soils at south tahrir province. Fayoum J. Agric. Res. and Dev., 19: 253-263.

26. Hunter, A. and A. Anders, 2004. The influence of humic acid on growth and development of creeping bentgrass. Acta Hort., 661: 257-264.

27. Hunter, A. and T. Butler, 2005. Effect of humic acid on growth and development of *Agrostis stolonifera* grass in a sand-based root zone. Inter. Turfgrass Soc. Res. J., 10: 937-943.