The 3rd Conf. of SSFOP "Recent Techniques in Ornamental Plants Scope", Cairo, Egypt, 26/2/2017
Scientific J. Flowers & Ornamental Plants
www.ssfop.com/journal
ISSN: 2356-7864

INFLUENCE OF SPRAYING WITH GA_3 AND SOME FERTILIZATION TREATMENTS ON QUALITY AND FLOWERING OF *BOUGAINVILLEA GLABRA CHOISY* PLANTS

Boshra A. El-Sayed, T.M. Noor El-Deen and Z.H. Riad

Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., ARC, Giza, Egypt.

Scientific J. Flowers & Ornamental Plants, 4(1):73-81 (2017).

Received:
26/12/2016
Accepted:
18/1/2017

ABSTRACT: A pot experiment was consummated under open field conditions at the nursery of Hort. Res. Inst., ARC., Giza, Egypt during 2015 and 2016 seasons to study the effect of spraying with gibberellic acid at 0, 500, 1000 and 1500 ppm concentrations (as a foliar spray 6 times with one month interval) and some fertilization treatments (without fertilization, NPK at 2 g/pot and phosphorein at 5 g/pot as soil drench) and their interactions on vegetative, flowering, root growth and chemical composition of 3-months-old *Bougainvillea glabra* plants grown in 20-cm-diameter plastic pots filled with a mixture of sand, loam and peatmoss (1:1:1, v:v).

The obtained results indicated that all fertilization treatments significantly improved all vegetative, flowering and root growth traits of the plants compared to control, especially the interaction treatments between NPK at 2 g/pot and gibberellic acid at 1500 ppm in all vegetative growth characters, leaves content of chlorophylls a and b, carotenoids and total carbohydrates, N, P and K % followed by the plants treated with phosphorein at 5 g/pot as a soil drench and GA_3 at 1500 ppm.

Hence, in order to get the best growth and high quality plants, it is recommended to treat the plants with NPK at 2 g/pot and spraying the foliage till run-off with 1500 ppm of GA_3 solution 6 times with one month interval.

Key words: *Bougainvillea glabra*, GA_3, NPK, phosphorein, vegetative growth, chemical composition.

INTRODUCTION

Bougainvillea glabra Choisy, paper flower is a weakly spinose, glabrous shrub or vine belongs to Fam. Nyctaginaceae. Bracts purple or magenta, flowering nearly continuously, native to Brazil. Of easy cultivation in any soil, thriving best in full sun and may be grown as pot plant in a cool greenhouse. Propagated mainly by cuttings with some difficult (Bailey, 1976).

Concerning the effect of gibberellic acid on growth and composition of plants, Ahmed *et al*. (2005) on *Peperomia obtusifolia* postulated that GA_3 at 400 ppm gave the tallest plants with the heaviest fresh and dry weights and the thickest stem, but the greatest leaf area was recorded when the plants were treated with GA_3 at 200 ppm concentration. In addition, El-Salami and Makary (1997) noticed that treatment of *Cupressus sempervirens* seedlings with GA_3 at the concentration of 200 ppm increased plant height, number of branches and fresh and dry weights of aerial parts and roots. Similarly, Abdel-Wahid (1999) concluded that GA_3 at the rate of 500 ppm increased plant height and branch number of *Ficus*

benjamina. On the same line, were those results of Saadawy *et al.* (2003) on *Rosa hybrida* cv. Mercedes, Gomaa (2003) on *Dahlia pinnata*, Eliwa (2003) on *Cupressus macrocarpa* and Agina *et al.* (2005) on *Bougainvillea glabra*, *Cordyline terminailis*, *Ficus microcarpa* Hawaii and *Jasminum sambac*.

Fertilization is still the most important agricultural process necessary for improving growth and quality of plants, especially flowering and foliage pot plants, among of them *Bougainvillea glabra* Choisy plants. This was emphasized by Poole and Chase (1987) who found that a 20 N - 9 P - 17 K fertilizer at the rate of 10.5 g/9 litres was generally the best treatment for growth and flowering of *Spathiphyllum* cv. Mauna Loa plants. Likewise, Poole and Conover (1992) mentioned that height and plant grade of *Spathiphyllum* cv. Petite were increased when the rate of 24N - 3.5P - 13K fertilizer was increased from 0.21 to 0.42 g/litre of water, but height was increased and plant grade did not improve when fertilizer rates rose beyond 0.42 g/litre. On the same cultivar (cv. Petite), Maciel *et al.* (2003) postulated that leaf number, fresh and dry weights of shoots; as well as number and fresh and dry weights of roots were significantly improved when 20:20:20 NPK + microelements fertilizer was applied as a foliar spray. On "Jetty" *Spathiphyllum*, Broschat (2006) revealed that using osmocote + 15-9-12 NPK fertilizer gave the greatest shoot and root dry weights, and the highest content of chlorophylls.

Nowadays, using of biofertilizers, as natural preparations containing one or more of beneficial microorganisms that can release nutrients from rocks and organic matter in the soil to become available for plants, has become one of the most important requirements to protect environments from pollution, besides getting a safe and clean product. Some of the microorganisms can fix atmospheric nitrogen in a free living state, e.g. *Azotobacter* and *Azospirillum* (Darwish, 2002). Moreover, *Azotobacter* bacteria secrete some growth promoting hormones, e.g. gibberellin, cytokinin-like substances, auxins, as well as some vitamins such as thiamine, riboflavin, pyridoxine, nicotinic and pantothenic acids (Darwish, 2002). Subba Rao (1993) indicated that *Azotobacter chroococcum* bacteria synthesize antifungal anti-biotics, which gave it an additional advantage for the use in the field of production. Giri *et al.* (2007). postulated that mycorrhizal *Acacia nilotica* plants maintained greater root and shoot biomass than non-mycorrhizal ones. AM-inoculated plants had higher P, Zn, Mn and Cu concentrations than uninoculated ones.

However, the current work aims to detect the beneficial effect of spraying with GA_3 at the rates of 0, 500, 1000, 1500 ppm and some fertilization treatments (NPK at the level of 0 and 2 g/pot and phosphorein at the level of 0 and 5 g/pot as a soil drench and the interaction between them on quality and flowering of paper flower (*Bougainvillea glabra* Choisy) plants.

MATERIALS AND METHODS

A study was consummated under open field at the nursery of Hort. Res. Inst., Giza, Egypt during 2015 and 2016 seasons to study the effect of spraying with GA_3 at the rates of 0, 500, 1000 and 1500 ppm and some fertilization treatments (NPK at the level of 0 and 2 g/l and phosphorein at the level of 0 and 5 g/pot as a soil drench) and their interaction to determine the most effective treatment for healthy growth, high quality and flowering of paper flower (*Bougainvillea glabra* Choisy) plants.

Three-months-old transplants of *Bougainvillea glabra* Choisy) plants (20-25 cm long with 10-15 leaves) were cultured on March, 1st in both seasons in 20-cm-diameter plastic pots (one transplant/pot) filled with a mixture of washed sand, loam and peatmoss (1:1:1, v/v/v). The physical and chemical analysis of the used sand and loam are shown in Table (a), but properties of the used peat are shown in Table (b).

Table a. Some physical and chemical properties of the used sand and loam during the two seasons.

Soil type	Seasons	Particle size distribution (%)				S.P	E.C. (ds/m)	pH	Cations (meq/l)				Anions (meq/l)		
		Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sandy	2015	84.76	6.29	1.50	7.45	21.87	3.71	7.80	19.42	8.33	7.20	0.75	1.60	7.80	26.30
	2016	88.01	5.27	1.19	8.53	22.18	3.99	7.32	17.53	7.53	8.99	0.54	2.18	8.01	18.03
Loamy	2015	10.30	46.54	18.88	24.28	33.07	3.36	7.96	18.00	8.95	20.50	0.85	3.65	10.20	34.25
	2016	10.33	48.19	18.77	22.71	33.38	3.35	7.99	19.03	8.85	21.55	0.84	3.02	10.29	35.68

Table b. Some physical and chemical properties of the used peatmoss in the two seasons.

Organic matter	90-95%	**K**	1.77 %
Ash	5-10%	**Fe**	421 ppm
Density (vol. dry)	85 mg/l	**Mn**	27 ppm
pH value	3.5	**Mg**	346 ppm
Water relation capacity	60-75%	**Zn**	41 ppm
Salinity	0.3 g/l	**Cu**	8.8 ppm
N	1.09 %	**B**	3.5 ppm
P	0.23%	**Mo**	1.2 ppm

After one month, the transplants received the following treatments:

1- No treatment, referred to as control.

2- Gibberellic acid in the form of Berelex tablets manufactured by ICI Co., England, as each tablet contains 1 g of gibberellin (92% GA_3), and was sprayed on the foliage till run-off at the concentrations of 0, 500, 1000 and 1500 ppm. Moreover, each level of GA_3 was combined with both of the dose of biofertilizer treatment (5 g of phosphrein/pot) and NPK at 2 g/pot to form twelve combined treatments.

3- Biofertilizer treatment, as the transplants were fertilized with phosphrein (a commercial product that contains a special clone of bacteria which changes the unavailable triphosphate to available monophosphate) at the rate of 5 g/pot. All treatments were repeated every 1 month interval, so the plants received such treatment 6 times throughout the course of the study, which was terminated on 30th of September for both seasons.

The layout of the experiment in the two seasons was a complete randomized design (Mead *et al*., 1993) with three replicates, as each replicate consisted of six plants.

At the end of each season (September, 30th) the following data were taken: plant height (cm), number of branches/plant, number of roots and number of flowers as well as, fresh and dry weights of vegetative parts, roots and flowers (g). However, in fresh leaf samples taken from the middle parts of the plants, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.) were determined according to Moran (1982). However, in dry samples, the content of total carbohydrates (Herbert *et al*., 1971), nitrogen using micro-Kjeldahle method (Jackson, 1973), phosphorus colorimetrically as recommended by Cottenie *et al.* (1982) and potassium using flame-photometer (Jackson, 1973), all of them as mg/g d.w. were measured.

Data were then tabulated and statistically analyzed according to SAS Institute (1994) using Duncan's Multiple Range Test

(Duncan, 1955) to compare among means of the different treatments.

RESULTS AND DISCUSSION

Effect of spraying with GA_3 and some fertilization treatments on:

Vegetative and root growth parameters:

As shown in Tables (1 and 2), it is clear that all vegetative and root growth parameters were improved with all treatments applied in this study, expressed as plant height (cm), number of branches/plant and root length (cm) as well as fresh and dry weights of vegetative and roots (g). However, the dominance in both seasons was for the interaction treatments between GA_3 at 1500 ppm and NPK at 2 g/pot which increased the means of all previous parameters to the highest values comparing with control, except for GA_3 at 1500 and phosphorein at 5 g/pot which resulted the increasing of number of branches/plant.

Flowering growth parameters:

Data averaged in Table (3) exhibit that number of flowers of the fertilized plants was significantly increased due to spraying with GA_3 only at the rate of 1000 ppm in the two seasons, and the mixture of phosphorein at the rate of 5 g/pot with spraying GA_3 at the rate of 1500 ppm slightly improved significant differences in both seasons. A similar trend was also attained concerning fresh and dry weights (g).

This may be ascribed to the role of GA_3 and phosphorein in enhancing plant growth which reflects afterward on flowering characteristics. GA_3 as a growth regulator induces cell enlargement and promotes internal biosynthesis.

Gavali (2010) described the role of bio-fertilizers in improving uptake and availability of essential macro and micronutrients due to its micro-organisms content. The bio-fertilizer used in current study (phosphorein) containing such micro-organisms (i.e. *Bacillus megaterium* which transfers the unavailable triphosphate to available monophosphate) and this could interpret the positive effect of phosphorein. On the same line, were those results of Maciel *et al.* (2003) on *Spathiphyllum* cv. Petite.

Chemical composition:

According to data presented in Table (4), it is clear that application of either GA_3 or some fertilizers (NPK and phosphorein), as well as their combinations markedly increased the content of photosynthetic pigments (chlorophylls a, b and carotenoids, as mg/g f.w.) in the leaves of treated plants.

Also from data shown in Table (5) it is clear that the percentage of N, P and K and total carbohydrates in the leaves were markedly increased as a result to spraying with GA_3 at 1500 ppm + NPK at 2 g/pot which registered the highest values at all. This may indicate the effect of both NPK and GA_3.

According to the aforementioned results, it could be recommended to fertilize the 3-months-old *Bougainvillea glabra* transplants grown in 20-cm-diameter plastic pots with 2 g/pot of NPK plus spraying the foliage with GA_3 till run off at the level of 1500 ppm 6 times with one month interval to get the best vegetative, flowering and root growth.

REFERENCES

Abdel-Wahid, S.M. (1999). Physiological Studies on *Ficus benjamina* L. Plant. Ph.D. Thesis, Fac. Agric., Cairo Univ.

Agina, Eman A.M.; Shalaby, H.S.; El-Khayat, A.S. and Korkor, H.M. (2005). Effect of foliar fertilization and some growth regulators on growth and chemical composition of some ornamental plants. Proc 6th Arab Conf. Hort., 20-22 March, Dept. Hort., Fac. Agric., Ismailia, Egypt, Abst.: 10.

Ahmed, G.E.F.; Abdel-Wahid, Safwat M.K. and Sabh, A.Z. (2005). Effect of baclobutrazol and gibberellic acid on *Peperomia obtusifolia* (L.) A. Dietr. plant. 1. Vegetative growth. Proc. 6th Arab Conf. Hort., March 20-22, Dept.

Table 1. Effect of spraying with GA_3 and some fertilization treatments on some vegetative growth parameters of *Bougainvillea glabra* Choisy plants.

Fertilization treatments / GA_3 concentrations	1st season				2nd season			
	W.F.	Phos.	NPK	Mean	W.F.	Phosp.	NPK	Mean
Plant height (cm)								
0 ppm	26.33 g	41.33 c	31.00 f	32.89 d	25.67 e	38.00 bc	30.67 d	31.44 d
500 ppm	37.00 de	40.33 cd	33.67 ef	37.00 c	34.00 cd	42.33 b	32.33 d	36.22 c
1000 ppm	41.67 bc	50.00 a	50.00 a	47.22 b	39.00 b	49.67 a	49.67 a	46.11 b
1500 ppm	45.67 b	52.67 a	53.67 a	50.67 a	50.33 a	52.67 a	53.67 a	52.22 a
Mean	37.67 c	46.08 a	42.08 b		37.25 c	45.67 a	41.58 b	
No. of branches/plant								
0 ppm	2.33 e	2.33 e	2.33 e	2.33 c	2.33 d	2.33 d	2.00 d	2.22 c
500 ppm	3.00 de	3.33 c-e	3.33 c-e	3.22 b	3.00 cd	3.33 cd	3.33 cd	3.22 b
1000 ppm	3.33 c-e	4.33 bc	3.33 c-e	3.67 b	4.00 bc	4.00 bc	3.33 cd	3.78 b
1500 ppm	5.00 ab	6.00 a	3.67 cd	4.89 a	6.00 a	5.00 ab	4.00 bc	5.00 a
Mean	3.42 ab	4.00 a	3.17 b		3.83 a	3.67 a	3.17 a	
Fresh weight of vegetative growth (g)								
0 ppm	21.33 f	29.67 cd	26.67 e	25.89 d	22.27 g	30.77 cd	27.60 ef	26.88 c
500 ppm	29.00 de	27.00 e	29.00 de	28.33 c	27.43 ef	26.23 f	29.77 de	27.81 c
1000 ppm	31.00 cd	32.00 bc	33.63 b	32.21 b	31.50 cd	32.80 cd	33.13 bc	32.48 b
1500 ppm	34.00 b	37.00 a	37.20 a	36.07 a	35.93 ab	37.23 a	38.03 a	37.07 a
Mean	28.83 b	31.42 a	31.63 a		29.28 b	31.76 a	32.13 a	
Dry weight of vegetative growth (g)								
0 ppm	14.45 g	18.52 fg	15.60 g	16.19 d	15.53 i	20.70 gh	17.80 hi	18.01 d
500 ppm	22.50 ef	22.07 f	16.30 g	20.29 c	20.00 gh	22.43 fg	21.70 g	21.38 c
1000 ppm	26.17 de	27.87 cd	34.37 b	29.47 b	26.10 ef	26.80 de	34.43 b	29.11 b
1500 ppm	31.93 bc	31.87 bc	40.94 a	34.91 a	30.23 cd	32.63 bc	41.93 a	34.93 a
Mean	23.76 b	25.08 ab	26.80 a		22.97 c	25.64 b	28.97 a	

W.F.: without fertilization, Phos.: phosphorein at 5 g/plant, NPK: NPK fertilization at 2 g/plant.
Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table 2. Effect of spraying with GA_3 and some fertilization treatments on some root growth parameters of *Bougainvillea glabra* Choisy plants.

Fertilization treatments / GA_3 concentrations	1st season				2nd season			
	W.F.	Phos.	NPK	Mean	W.F.	Phosp.	NPK	Mean
Root length (cm)								
0 ppm	8.62 h	12.70 e-g	9.87 gh	10.40 d	10.75 i	15.71 ef	12.61 g-i	13.02 c
500 ppm	14.91 e	13.21 ef	10.90 f-h	13.01 c	13.78 f-h	14.51 fg	11.90 hi	13.40 c
1000 ppm	18.99 d	18.78 d	28.60 b	22.12 b	17.48 de	18.45 cd	28.58 b	21.50 b
1500 ppm	21.71 cd	23.97 c	32.01 a	25.90 a	20.62 c	20.65 c	31.94 a	24.40 a
Mean	16.06 b	17.16 b	20.34 a		15.65 c	17.33 b	21.26 a	
Root fresh weight (g)								
0 ppm	1.49 f	2.97 ef	2.94 ef	2.46 c	1.96 f	3.13 d	2.92 de	2.67 c
500 ppm	3.51 e	5.12 cd	1.86 f	3.49 b	3.30 d	5.07 c	2.23 ef	3.53 b
1000 ppm	4.16 de	5.93 bc	7.13 ab	5.74 a	4.72 c	6.69 b	7.00 ab	6.14 a
1500 ppm	4.49 c-e	7.37 ab	7.93 a	6.60 a	4.34 c	7.53 a	7.48 a	6.45 a
Mean	3.41 b	5.34 a	4.97 a		3.58 c	5.60 a	4.91 b	
Root dry weight (g)								
0 ppm	0.69 f	1.46 ef	1.02 f	1.06 c	0.96 g	1.41 fg	1.15 fg	1.17 c
500 ppm	1.50 ef	2.94 cd	0.86 f	1.77 b	1.71 ef	3.07 cd	0.87 g	1.89 b
1000 ppm	2.54 cd	3.48 bc	3.43 bc	3.15 a	2.88 d	4.00 ab	3.26 cd	3.38 a
1500 ppm	2.43 de	4.46 a	3.97 ab	3.62 a	2.20 e	4.44 a	3.64 bc	3.43 a
Mean	1.79 c	3.09 a	2.32 b		1.94 c	3.23 a	2.23 b	

W.F.: without fertilization, Phos.: phosphorein at 5 g/plant, NPK: NPK fertilization at 2 g/plant.
Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table 3. Effect of spraying with GA_3 and some fertilization treatments on some flowering characteristics of *Bougainvillea glabra* Choisy plants.

Fertilization treatments / GA_3 concentrations	1st season				2nd season			
	W.F.	Phos.	NPK	Mean	W.F.	Phosp.	NPK	Mean
No. of flowers								
0 ppm	7.00 de	7.33 de	7.00 de	7.11 b	7.00 d-f	6.00 ef	7.33 c-f	6.78 c
500 ppm	8.67 cd	12.33 ab	4.00 e	8.33 b	9.67 b-d	12.67 ab	4.00 f	8.78 b
1000 ppm	15.67 a	11.33 bc	8.67 cd	11.89 a	15.33 a	10.67 bc	9.00 c-e	11.67 a
1500 ppm	4.67 e	12.67 ab	4.67 e	7.33 b	4.00 f	13.00 ab	5.00 f	7.33 bc
Mean	9.00 b	10.92 a	6.08 c		9.00 a	10.58 a	6.33 b	
Flowers fresh weight (g)								
0 ppm	1.18 d-f	1.37 de	1.25 d-f	1.27 b	1.16 c-f	1.06 d-f	1.24 c-f	1.15 b
500 ppm	1.40 de	2.51 b	0.53 g	1.48 b	1.46 c-e	2.44 ab	0.61 f	1.50 b
1000 ppm	3.15 a	2.23 bc	1.68 cd	2.35 a	2.89 a	1.87 bc	1.72 b-d	2.16 a
1500 ppm	0.94 e-g	2.09 bc	0.74 fg	1.26 b	0.88 ef	2.68 a	0.95 ef	1.50 b
Mean	1.67 b	2.05 a	1.05 c		1.60 b	2.01 a	1.13 c	
Flowers dry weight (g)								
0 ppm	0.78 c-e	0.89 cd	0.88 cd	0.85 b	0.78 c-f	0.90 c-f	0.97 c-e	0.88 b
500 ppm	1.05 b-d	1.45 b	0.36 e	0.96 b	1.02 b-d	1.45 ab	0.57 d-f	1.01 b
1000 ppm	2.07 a	1.21 bc	0.98 b-d	1.42 a	1.71 a	1.23 bc	1.02 b-d	1.32 a
1500 ppm	0.71 de	1.23 bc	0.38 e	0.77 b	0.45 f	1.70 a	0.54 ef	0.90 b
Mean	1.15 a	1.20 a	0.65 b		0.99 b	1.32 a	0.78 b	

W.F.: without fertilization, Phos.: phosphorein at 5 g/plant, NPK: NPK fertilization at 2 g/plant.
Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table 4. Effect of spraying with GA_3 and some fertilization treatments on pigment contents of *Bougainvillea glabra* Choisy plants.

Fertilization treatments / GA_3 concentrations	Chlorophyll a (mg/g)				Chlorophyll b (mg/g)				Carotenoids (mg/g)			
	W.F.	Phos.	NPK	Mean	W.F.	Phosp.	NPK	Mean	W.F.	Phos.	NPK	Mean
0 ppm	0.290 de	0.180 f	0.340 cd	0.270 c	0.292 a-c	0.241 bc	0.294 a-c	0.276 a	0.071 bc	0.050 c	0.059 bc	0.060 a
500 ppm	0.370 bc	0.260 e	0.390 bc	0.340 b	0.311 ab	0.231 c	0.284 a-c	0.275 a	0.072 bc	0.110 a	0.053 bc	0.078 a
1000 ppm	0.390 bc	0.280 de	0.400 bc	0.357 b	0.303 a-c	0.146 d	0.322 a	0.257 a	0.070 bc	0.067 bc	0.051 c	0.063 a
1500 ppm	0.420 b	0.290 de	0.520 a	0.410 a	0.295 a-c	0.329 a	0.266 a-c	0.297 a	0.066 bc	0.086 ab	0.041 c	0.064 a
Mean	0.368 b	0.253 c	0.413 a		0.300 a	0.237 b	0.291 a		0.070 a	0.078 a	0.051 b	

W.F.: without fertilization, Phos.: phosphorein at 5 g/plant, NPK: NPK fertilization at 2 g/plant.
Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table 5. Effect of spraying with GA_3 and some fertilization treatments on some chemical constituents of *Bougainvillea glabra* Choisy plants.

Fertilization treatments / GA_3 concentrations	N %				P %				K %				Total carbohydrates %			
	W.F.	Phos.	NPK	Mean	W.F.	Phos.	NPK	Mean	W.F.	Phos.	NPK	Mean	W.F.	Phos.	NPK	Mean
0 ppm	1.55 d	2.21 b	2.65 a	2.14 c	0.31 e	0.43 d	0.52 cd	0.42 d	0.60 f	0.63 ef	0.75 c-e	0.66 c	28.75 c	32.58 c	35.31 bc	32.21 c
500 ppm	1.77 cd	2.65 a	2.72 a	2.38 bc	0.44 d	0.47 d	0.60 bc	0.50 c	0.61 ef	0.72 d-f	0.89 bc	0.74 bc	29.09 c	33.41 bc	40.22 b	34.24 bc
1000 ppm	1.99 bc	2.65 a	2.73 a	2.46 ab	0.61 bc	0.63 bc	0.64 b	0.63 b	0.66 d-f	0.79 b-d	0.90 b	0.78 b	30.41 c	34.00 bc	49.27 a	37.89 ab
1500 ppm	2.21 b	2.88 a	2.92 a	2.67 a	0.65 b	0.67 b	0.90 a	0.74 a	0.69 d-f	0.89 bc	1.06 a	0.88 a	31.89 c	34.69 bc	52.92 a	39.83 a
Mean	1.88 b	2.60 a	2.76 a		0.50 b	0.55 b	0.67 a		0.64 c	0.76 b	0.90 a		30.03 c	33.67 b	44.43 a	

W.F.: without fertilization, Phos.: phosphorein at 5 g/plant, NPK: NPK fertilization at 2 g/plant.
Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Hort., Fac. Agric., Ismailia, Egypt: 65-75.

Bailey, L.H. (1976). Hortus Third. Macmillan Puplishing Co., Inc., 866 Third Avenue, New York, N.Y. 10022, 1290 pp.

Broschat, T.K. (2006). Effect of phosphorus and phosphoric acid on growth and phosphorus concentration in container grown tropical ornamental plants. HortTech., 16(1):105-108.

Cottenie, A.; Verloo, M.; Kiekan, L.; Velghe, G. and Comerlynck, R. (1982). Chemical Analysis of Plants and Soils. Laboratory of Analytical and Agrochemistry. State Univ., Ghent-Belgium, 44-45.

Darwish, F.M. (2002). Effect of Different Fertilizer Sources and Levels on Growth, Yield and Quality of Tomato. Ph.D. Thesis, Fac. Agric, Cairo Univ., Egypt.

Duncan, D.B. (1955). Multiple Range and Multipile F-Test. J. Biometrics, 11:1-42.

Eliwa, Naglaa Y.L. (2003). Effect of gibberellic acid and chemical fertilization on growth and chemical composition on *Cupressus macrocarpa* seedlings. Proc. the First Egyptian-Syrian Conference for Agriculture and Food in The Arab World. Minia Univ., Egypt 8-11th December 2003.

El-Salami, I.H. and Makary, B.S. (1997). Response of *Cupressus sempervirens* L. seedlings to gibberellic acid and foliar nutrition. Assuit J. Agric. Sci., 28(1):21-35.

Gavali, P. (2010). Effect of Integrated Nutrient Management on Growth, Flowering and Yield in Rose (*Rosa indica* L.) cv. Sophia Loren. M.Sc., College of Horticulture, Andhra Pradesh Horticultural University, Hyderabad, India, 113 p.

Giri, B.; Kapoor, R. and Mukerji, K.G. (2007). Improved tolerance of *Acacia nilotica* to salt stress by arbuscular mycorrhiza, *Glomus fasciculatum*, may be partly related to elevated K^+/Na^+ ratios in root and shoot tissues. Microbial Ecology, 54(4):753–760.

Gomaa, A.O. (2003). Effect of foliar spraying with gibberellic acid and calcium on growth and flowering of *Dahlia pinnata* plants. Egypt. J. Agric. Res., NRC, 1(3):585-605.

Herbert, D.; Philips, P.J. and Strange, R.E. (1971). Determination of total carbohydrates. Methods in Microbiology, 5(8):290-344.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentic-Hall of India Private Ltd. M-97, New Delhi, India. 498 pp.

Maciel, N.; Mogollon, N. and Casares, C. (2003). Effect of substrate and fertilizers on growth of *Spathiphyllum* "Petite". Proc. Interamerican Soc. Trop. Hort., 46:103-105.

Mead, R.; Curnow, R.N. and Harted, A.M. (1993). Statistical Methods in Agriculture and Experimental Biology. 2nd Ed., Chapman & Hall Ltd., London, 335 p.

Moran, R. (1982). Formula for determination of chlorophyllous pigment extracted with N-N-dimethyl formamide. Plant Physiol., 69:1376-81.

Poole, R.T. and Chase, A.R. (1987). Response of foliage plants to fertilizer application rates and associated leachate conductivity. HortScience, 22:317-318.

Poole, R.T. and Conover, C.A. (1992). Fertilizer levels and medium affect foliage plant growth in an ebb and flow irrigation system. J. Environ. Hort., 10(2):81-86.

Saadawy, F.M.; Abo-Taleb, N. and Gomaa, S.A.A (2003). Effect of pruning and growth regulators on rose growth and flowering. II. Gibberellic acid application. J. Agric. Res., Tanta Univ., 29(2):515-537.

SAS Institute (1994) SAS/STAT User's Guide: Statistics. Vers. 6.04, 4th Ed., SAS Institute Inc., Cary, N.C., USA.

تأثير الرش بحمض الجبريلليك وبعض معاملات التسميد على جودة وإزهار نباتات الجهنمية

بشره عبدالله السيد محمد، طارق محمد نور الدين أحمد، زكي حلمي رياض
قسم بحوث الزينة وتنسيق الحدائق، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر.

أجريت تجربة أصص بالحقل المفتوح بمشتل معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠١٥ و ٢٠١٦ لدراسة تأثير الرش بحمض الجبريلليك بمعدلات صفر، ٥٠٠، ١٠٠٠، ١٥٠٠ جزء في المليون وبعض معاملات التسميد (بدون تسميد، NPK بمعدل ٢جم/إصيص و الفوسفورين بمعدل ٥ جم/أصيص كإضافة أرضية) والتفاعل بينهم على النمو الخضري، الجذري، التزهير والتركيب الكيماوي لنباتات الجهنمية عمر ثلاثة أشهر والمنزرعة في أصص بلاستيك قطرها ٢٠سم ومملوءة بخليط متساوي من الرمل + الطمي + البيت موس بنسبة ١:١:١ حجماً.

أوضحت النتائج المتحصل عليها أن جميع معاملات التسميد احدثت تحسناً معنوياً في النمو الخضري، الزهري والجذري للنباتات موضع الدراسة مقارنة بالكنترول خاصة المعاملة المشتركة بين التسميد بـ NPK بمعدل ٢جم/أصيص + الرش بحمض الجبريلليك بمعدل ١٥٠٠ جزء في المليون والتي أعطت أفضل النتائج في جميع الصفات الخضرية، الجذرية، الزهرية وكذلك في محتوى الأوراق من الصبغات والكربوهيدرات الكلية وزيادة النسبة المئوية لكلاً من النيتروجين والفوسفور والبوتاسيوم بالمقارنة بالكنترول يليها المعاملة المشتركة بين الفوسفورين بمعدل ٥جم/أصيص + حمض الجبريلليك بمعدل ١٥٠٠ جزء في المليون.

وعليه يمكن التوصية بزراعة نباتات الجهنمية عمر ٣ أشهر في مخلوط الرمل + الطمي + البيت موس (١:١:١ حجماً) مع التسميد بالسماد NPK بمعدل ٢جم/أصيص والرش بحمض الجبريلليك بمعدل ١٥٠٠ جزء في المليون ٦ مرات وبفاصل شهر بين كل رشتين متتاليتين خلال موسم النمو للحصول على أعلى جودة وأفضل نمو.