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FOLIAR APPLICATION OF SALICYLIC ACID AND GIBBERELLIC ACID ENHANCES GROWTH AND FLOWERING OF *Ixora coccinea* L. PLANTS

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ABSTRACT

Foliar application effects of salicylic acid (SA) and gibberellic acid (GA_3) were investigated on growth and flowering of *Ixora coccinea* L. plants. Four concentrations (100, 200, 300 and 400 ppm) of both SA and GA_3 were sprayed in addition to the control (water-sprayed plants). Results indicated that all growth and flowering characteristics of Ixora plants were increased by all concentrations of SA or GA_3 compared to the untreated plants. Concerning salicylic acid, the lowest concentration (100 ppm) produced the highest plants while 200 ppm increased leaf area and shoot/root ratio. Number of leaves and plant pigments (chlorophyll a, b, a+b and carotenoids) were increased at 300ppm concentration. Spraying the plants with 400ppm increased fresh and dry weight of shoots and roots and flower number. GA_3 sprayers at 300 or 400ppm led to a significant increase in most of the characteristics studied in comparison to the untreated plants. The correlation coefficient among most of Ixora vegetative and flowering growth characteristics proved to be significant.

Keywords: *Ixora coccinea*; flowering plants; growth regulators; gibberellin; plant hormones.

INTRODUCTION

Ixora coccinea belongs to family Rubiaceae is cultivated throughout the tropics as an ornamental plant. Ixora belongs to shrubs and small trees distributed in the tropical and sub- tropical regions. They are beautiful garden plants grown for their cluster of flowers, various hues and evergreen foliage and known to possess anti-carcinogens in them and prove to be an effective remedy against tuberculosis (Malathy and Pai, 1998). The common name "flame of woods" was given to this tropical plant because of its brilliant red flowers, which remains open for a long time, contrast with the glossy, dark green leaves. They grow well in acidic soil and can be raised by seeds and cuttings (Holttum and Enoch, 1991).

Growth regulators such as salicylic acid (SA) and gibberellic acid (GA_3) are usually used to regulate growth and flowering of ornamental flowering plants Salicylic acid (SA) is a phenolic compound of hormonal nature produced by plants and plays an important role in responses to several abiotic stresses and to pathogen attack (Noreen *et al*. 2009, Abdelaal, 2015). SA has also been studied for its effects on various physiological processes related to growth and development of plants under normal conditions (no stress). Among these effects are the induction of flowering in herbaceous species (Hegazi and El-Shrayi, 2007), stimulation of root development, stomatal closure and reduced transpiration (Singh and Usha, 2003), reversal of the effects of abscisic acid (Davies, 2004) and regulation of gravitropism (Hussein *et al*., 2007). The effect of SA as an endogenous regulator of flowering was demonstrated in a number of plant species belonging to different families (Hayat *et al*., 2007). In addition to regulate flowering time, SA also links defense responses and reproductive development (Martínez *et al*., 2004).

Gibberellins are a class of endogenous plant growth substances actively involved in the control of a number of key developmental processes including endosperm mobilization and stem elongation, as well as flower and fruit development (Huttly and Phillips, 1995) Plants subjected to exogenous application of gibberellins have been found to exhibit increased activities of carbonic anhydrase, nitrate reductase (Afroz *et al*., 2005), CO_2 fixation and stomatal conductance (Bishnoi and Krishnamoorthy, 1992). Moreover, GA_3 acts as a mediator for acclimation of plants to leaf canopy, stimulates leaf area expansion (Davies, 1995) and induces elongation and osmoregulation in internodes (Azuma *et al*., 1997) in addition to increasing dry matter and biomass production (Gupta and Datta, 2001) and greatly enhancing the sink potential (Ouzounidou and Ilias, 2005).

The main objective of the current study was to investigate the effects of salicylic acid and gibberellic acid and to determine the optimum concentration of each of them that gives the best growth and flowering of potted Ixora plants.

MATERIALS AND METHODS

The current experiment was conducted at the Experimental Farm of Ornamental Plants and Landscape Gardening Department, Faculty of Agriculture, Assiut University, Assiut, Egypt during 2012-2013 and 2013-2014 seasons to evaluate the influence of foliar application of salicylic acid (El-Nasr Co. for Intermediate Chemicals, Egypt (NCIC)) and GA_3 (S.D. Fine-Chem Limited, India) on growth and flowering of *Ixora coccinea* L. plants. Uniform 9-month old plants of *Ixora. coccinea* L. (13±1 cm height and 10±1 leaves) were planted on mid of February for the two seasons in 20 cm diameter plastic pots filled with about 4.5 l of an equal mixture of peat moss (Floratorf Company) and perlite (1:1 v/v). The Experiment was arranged in RCBD design and divided into three replicates with nine treatments; each treatment contained six pots. The concentrations used were control (water sprayed), 100, 200, 300 and 400 ppm of each of SA and GA_3. Plants were foliar sprayed (till run off) four times at 3 weeks interval and the first treatment was applied two weeks after transplanting.

Data recorded were; plant height (cm), branches number/plant, leaf number/plant, leaf area (cm^2) measured using Digital Image Analysis according to O'Neal *et al*. (2002), total leaf area/plant (cm^2), fresh and dry weights of both shoots and roots (g), shoot/root ratio, flower number/plant, florets number/flower and flower weight (g). Chlorophyll a, b, chlorophyll a + b and carotenoids were calculated as mg/g fw.

Chlorophyll a, b and carotenoids were determined according to the acetone incubation method described by Krishnan *et al*. (1996). Leaf samples (100 mg) were placed in a graduated tube containing 25 ml of 80% acetone and the chlorophyll was extracted without grinding and centrifugation, by incubating the leaf tissues into the solvent in a dark place at incubation temperatures of 4°±2°. The contents of the tubes were shaken occasionally to accelerate the pigments extraction. After 48 hours of incubation the extract liquid was filtered through glass wool to remove leaf pieces and transferred to another graduated tube. The liquid extract then was made up to a total volume of 25 ml with 80% acetone. The chlorophyll content was spectrophotometrically analysed, in a UV visible spectrophotometer (Optizen Pop, Mecasys - Korea) using 3 ml sealed quartz-glass cuvettes with a path length of 1 cm. The chlorophyll content was calculated as mg/g fw following the equations cited in Dere *et al*. (1998);

$$\text{Chlorophyll a} = 11.75\ A_{662} - 2.350\ A_{645}$$

$$\text{Chlorophyll b} = 18.61\ A_{645} - 3.960\ A_{662}$$

$$\text{Carotenoids} = 1000\ A_{470} - 2.270\ \text{Chlorophyll a} - 81.4\ \text{Chlorophyll b}/227$$

Data were subjected to the statistical analysis using "F" test. Means were compared using the least significant differences (LSD) test at 5% level of probability according to Gomez and Gomez (1984).

RESULTS

1. Vegetative characteristics:

The foliar application of either SA or GA_3 proved significantly superior to the control (water sprayed plants) concerning all vegetative growth characteristics of Ixora plants as shown in Table (1). GA_3-treated plants showed generally better growth than SA treatments. The highest concentration of GA_3 (400 ppm) gave the tallest plants (61.58 and 75.42 cm), branch number (2.92 and 3.08) and leaf number (51.92 and 81.08) during both seasons, respectively.

SA at 200ppm increased leaf area recording the highest values (22.74 and 23.26 cm^2 during booth seasons, respectively) and total leaf area during the first season only (996.72 cm^2) and recorded 81 and 91% in leaf area higher than the control during both seasons, respectively. On the other hand, a significant reduction in plant height was found in most cases as the concentration of SA was increased, where plant treated with 100 ppm SA were 36 and 25% taller than the untreated plants in both seasons, respectively

Table (1). Effect of SA and GA_3 at different concentrations on some vegetative characteristics of *Ixora coccinea* L. plants during 2012/2013 (1^{st}) and 2013/2014(2^{nd}) seasons.

Treatments	Conc. (ppm)	Plant height (cm)		Branch number/plant		Leaf number/plant		leaf area (cm^2)		Total leaf area/plant (cm^2)	
		1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}
Control		38.25 e	39.17 c	1.33 b	2.50 a	34.58 d	46.42 c	12.55 c	12.20 d	434.18	566.14
SA	100	52.00 bc	48.92 b	1.42 b	2.42 a	37.75 cd	51.58 c	17.63 b	19.17 abc	665.70	988.80
	200	43.83 cde	47.42 b	1.50 b	2.92 a	43.83 bc	53.17 c	22.74 a	23.26 a	996.72	1236.51
	300	43.50 cde	41.67 bc	1.67 b	3.08 a	44.00 bc	56.83 bc	19.75 ab	20.68 abc	869.13	1175.06
	400	43.08 de	41.50 bc	1.50 b	3.00 a	43.50 bc	53.75 c	19.31 ab	19.53 abc	840.02	1049.62
GA_3	100	43.67 cde	70.08 a	1.42 b	2.50 a	36.25 cd	71.33 ab	12.58 c	16.41 bcd	455.91	1170.79
	200	49.50 bcd	72.33 a	2.42 a	2.92 a	47.00 ab	74.00 a	15.78 bc	16.93 bcd	741.58	1252.93
	300	55.17 ab	74.25 a	2.67 a	3.17 a	50.92 ab	75.58 a	15.64 bc	16.18 cd	796.49	1222.57
	400	61.58 a	75.42 a	2.92 a	3.08 a	51.92 a	81.08 a	17.37 b	21.46 ab	901.97	1739.93

*** Means within the same column followed by different letters are significantly different ($P \leq 0.05$) based on LSD.**

Data presented in Table (2) show that spraying Ixora plants with GA_3 promoted shoot fresh and dry weights, but root fresh and dry weights were enhanced by the application of SA. Increasing the concentration of either SA or GA_3 led to a significant increase in Ixora plant fresh and dry weights. Plants treated with the highest concentration of GA_3 (400 ppm) were characterized by the heaviest shoot fresh weight in both seasons (26.87 and 41.33 g, respectively) and shoot dry weight in the second season (16.22 g), in addition to the best shoot-root ratio (2.37 and 2.65, respectively). SA treatment at 400 ppm produced the heaviest roots fresh weight (15.18 g and 25.33 g) and roots dry weight (4.94 and 7.60 g) in both seasons, respectively.

Table (2). Effect of SA and GA_3 at different concentrations on shoot and root fresh and dry weights of *Ixora coccinea* L. plants during 2012/2013 (1st) and 2013/2014(2nd) seasons.

Treatments	Conc. (ppm)	Shoot fw (g)		Shoot DW g		Root FW g		Root DW g		Shoot/Root ratio	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control		12.78 e	18.67 e	3.41 f	5.25 g	9.38 e	16.00 d	2.33 f	3.58 f	1.47	1.47
SA	100	17.33 d	26.67 d	5.98 d	9.21 e	11.48 d	17.67 cd	3.35 e	5.15 e	1.79	1.79
	200	17.92 cd	27.00 cd	7.46 b	11.47 c	12.57 cd	19.33 bcd	3.77 cd	5.80 cd	2.00	2.00
	300	20.37 bc	31.33 b	7.57 b	11.65 c	14.52 ab	22.33 ab	4.47 b	6.88 b	1.70	1.70
	400	21.67 b	33.33 b	9.72 a	14.96 b	15.18 a	25.33 a	4.94 a	7.60 a	1.97	1.97
GA_3	100	18.35 cd	29.67 bcd	4.96 e	7.64 f	13.00 bcd	20.00 bc	3.29 e	5.06 e	1.51	1.51
	200	19.50 bcd	30.00 bcd	5.98 d	9.20 e	13.22 bc	20.33 bc	3.47 de	5.33 de	1.73	1.73
	300	20.15 bc	31.00 bc	6.68 c	10.27 d	14.52 ab	22.33 ab	4.56 ab	7.02 ab	1.46	1.46
	400	26.87 a	41.33 a	9.41 a	16.22 a	13.87 abc	21.33 b	3.98 c	6.12 c	2.37	2.65

* **Means within the same column followed by different letters are significantly different ($P \leq 0.05$) based on LSD.**

2 Flowering characteristics

As illustrated in Fig. (1). GA_3 treatment at 400 ppm significantly increased flower number in the first season (7.67 flowers/plant) followed by SA at either 300 or 400 ppm. Adversely, SA at 400 ppm produced 8.33 flowers/plant in the second season which was non-significantly superior to 400 ppm GA_3 (7.0 flowers/plant). The highest floret number/flower was obtained in Ixora plants treated with either GA_3 at either 300 ppm or SA at 400 ppm in both seasons. The heaviest flower was noticed in plants treated with GA_3 at 400 ppm in both seasons (5.54 and 5.67 g, respectively) which was non-significantly followed by 300 ppm GA_3 (4.62 and 4.69 g, respectively). The differences between 300 ppm GA_3 and the other treatments including the control were proved non-significant.

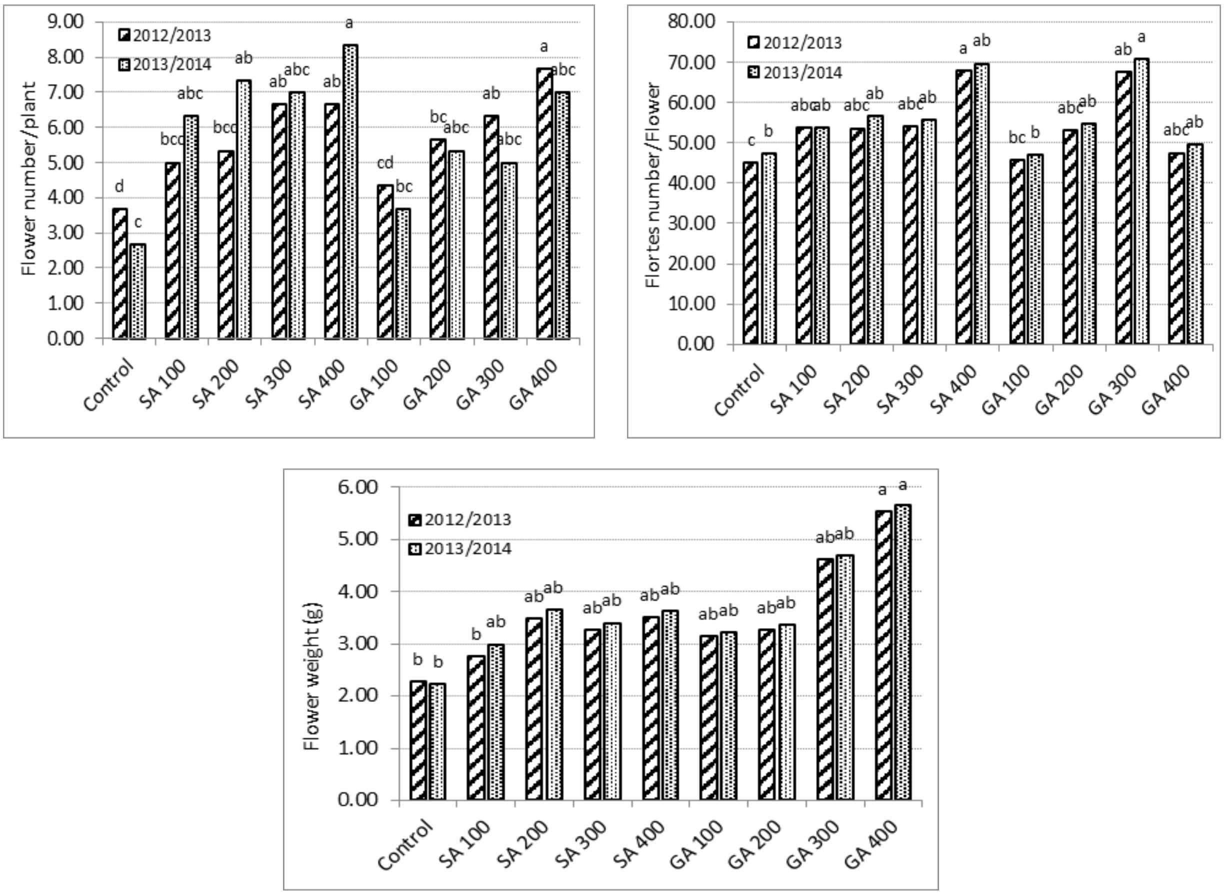

Fig 1. Effect of SA and GA_3 at different concentrations on flower characteristics of *Ixora coccinea* L. plants during 2012/2013 and 2013/2014 seasons.

3. Leaf pigments content

It was observed that SA at 300 ppm concentration showed higher chlorophyll a, b and carotenoids contents than the other concentrations (Table 3). The increment in chlorophyll a was approximately 52 and 37% in both seasons, respectively comparing to the control. These values were 58 & 53% for chlorophyll b and 18 & 23% for carotenoids. Concerning GA_3, only chlorophyll a was significantly increased at 300 and 400 ppm during the second season.

Table (3). Effect of SA and GA_3 at different concentrations on leaf pigments content of *Ixora coccinea* L. plants during 2012/2013 (1^{st}) and 2013/2014(2^{nd}) seasons.

Treatments	Conc. (ppm)	Chlorophyll a (mg/g fw)		Chlorophyll b (mg/g fw)		Chlorophyll a+b		Carotenoids (mg/g fw)	
		1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}
Control		0.226 c	0.243 c	0.081 b	0.079 b	0.307	0.322	0.165 abc	0.152 bc
SA	100	0.302 ab	0.290 ab	0.114 ab	0.101 ab	0.417	0.391	0.199 a	0.179 ab
	200	0.309 ab	0.304 a	0.100 ab	0.100 ab	0.409	0.403	0.171 abc	0.171 ab
	300	0.343 a	0.332 a	0.128 a	0.121 a	0.471	0.453	0.194 ab	0.187 a
	400	0.285 abc	0.310 a	0.093 b	0.108 a	0.378	0.418	0.158 abc	0.179 ab
GA_3	100	0.228 c	0.260 bc	0.105 ab	0.108 ab	0.333	0.368	0.172 abc	0.178 ab
	200	0.259 bc	0.261 bc	0.098 ab	0.102 ab	0.357	0.363	0.136 c	0.137 c
	300	0.282 abc	0.303 ab	0.110 ab	0.107 ab	0.391	0.410	0.149 bc	0.152 bc
	400	0.286 abc	0.316 a	0.092 b	0.099 ab	0.379	0.416	0.134 c	0.138 c

*** Means within the same column followed by different letters are significantly different ($P \leq 0.05$) based on LSD.**

4. The correlation coefficients matrix

The correlation matrix presented in Table (4) revealed significant correlation coefficient values at $p \leq 0.05$ among most of Ixora vegetative growth and flowering characteristics. Among the most obvious significant correlations are that between flower number/plant and each of shoot dry weight (r=0.73 & 0.54), root dry weight (r= 0.65 & 0.38) in both seasons, respectively. Chlorophyll a was significantly correlated with shoot dry weight (r=0.46 & 0.65), root dry weight (r=0.49 & 0.54) and leaf area (r=0.42 & 0.41) in both seasons, respectively. Meanwhile, carotenoids negatively and significantly correlated with plant height in both seasons (r= -0.49 & -0.46).

DISCUSSION

The current experiment proved that growth and flowering of Ixora plant could be improved by the application of either SA or GA_3. The highest concentration of GA_3 (400 ppm) resulted in the highest values of plant height, branch number, leaf number, leaf area/plant, fresh and dry weights of shoots, shoot-root ratio, flower number and weight in addition to high leaf content of chlorophyll a and b. The positive correlation among most of these characteristics as indicated in Table (4) could explain the enhancement in overall growth obtained by the GA_3 at 400 ppm. For example flower number, as an important characteristic of Ixora plant, is positively and significantly correlated with all vegetative and biomass characteristics in addition to leaf content of chlorophyll a. The percentage of the variation in the flower number/ plant was accounted for by the linear function of the aforementioned growth characteristics as could be calculated through the equation [100 $(r)^2$] (Gomez and Gomez 1984). The positive variation in flower number/plant reaching 25, 16, 32, 59, 53 and 22% is accounted for by the positive linear function of plant height, branch number, leaf number, shoot fresh weight, shoot dry weight and leaf content of chlorophyll a, respectively.

The favorable effect of GA_3 foliar application on plant growth has been reported previously by several investigators. GA_3 was found to improve the whole plant growth (Davies *et al*., 2009), plant height, stem elongation, leaf expansion and flower development (Davies, 1995), plant dry mass, leaf area, plant growth rate and crop growth rate (Khan *et al*. 2002), flowering (Asil *et al*., 2011). An explanation of the significant increase in plant height in GA_3-treated plants could be the growth promotion effect of GA_3 in stimulating and accelerating cell division, increasing cell elongation and enlargement, or both (Hartmann *et al*., 1990). Other investigators indicated the involvement of GA_3 in cell elongation such as Ohkawa (1979). Flowering promotion by GA_3 could be also interpreted upon its effect on enhancing photosynthetic activity (Kim and Miller, 2009). The role of GA_3 in inducing the net photosynthetic rate, stomatal conductance, and chlorophyll concentration could explain its positive effect on plant growth and flowering.

GA_3 resulted in a moderate root fresh and dry values comparing to SA. This is supported by the findings of Aftab *et al*. (2011) who reported non-significant effect of GA_3 on total biomass of the plants. The treatments of SA proved superior to GA_3 treatments regarding leaf area, fresh and dry weight of roots and leaf content of chlorophyll a. Plants treated with SA at 200 ppm were characterized by the widest leaves which were non-significantly different for those treated with the higher concentrations (300 and 400 ppm).

The heaviest fresh and dry roots and the highest leaf content of chlorophyll a were found in plants sprayed with SA at either 300 or 400 ppm with non-significant differences in between. SA improved Ixora flowering characteristics as well. The highest values of flower number/plant, floret number/flower and flower weight were shared between SA at 400 ppm and GA_3 at 400 ppm. A significant correlation confident was found between both leaf area and root dry weight which were both significantly enhanced by SA treatments. Approximately 20% of positive variation in leaf area is accounted for by the positive linear function of root dry weight. The correlation coefficient was also significant between chlorophyll a and each of leaf area and fresh and dry weight of shoots and roots. All these facts proved the highly positive effect of SA in boosting Ixora plant photosynthesis which is directly reflected on plant vegetative, flowering and biomass characteristics. These results are in accordance with those obtained by several previous investigators such as Nagasubramaniam *et al*. (2007) who found that leaf area, crop growth rate and total dry matter production in baby corn were increased by the application of SA (7.2 $\times 10^{-4}$). The effect of SA on improving plant dry mass was also revealed by Singh and Usha (2003). Jeyakumar *et al*. (2008) reported also an enhancement in dry matter production in black gram by the treatment of SA (10^{-4} M). They also found an effect on plant height and shoot and root dry weights. Foliar application of salicylic acid increased the leaf area of sugarcane as found by Zhou *et al*. (1999).

Table (4). Correlation coefficients matrix (r) of growth characteristics of *Ixora coccinea* L. plants as affected by the foliar application of SA and GA_3 at different concentrations during 2012/2013 (1st) and 2013/2014 (2nd) seasons.

Characteristics	Season	Plant height	Branch number/plant	Leaf number/plant	Leaf area	Shoot fw	Shoot dw	Root fw	Root dw	Flower number/plant	Floret number/flower	Flower weight	Chlorophyll a	Chlorophyll b
Branch number/plant	1st	0.65*	-	-	-	-	-	-	-	-	-	-	-	-
	2nd	0.03	-	-	-	-	-	-	-	-	-	-	-	-
Leaf number/plant	1st	0.53*	0.82*	-	-	-	-	-	-	-	-	-	-	-
	2nd	0.79*	0.43*	-	-	-	-	-	-	-	-	-	-	-
Leaf area	1st	0.06	-0.10	0.25	-	-	-	-	-	-	-	-	-	-
	2nd	0.09	0.06	0.09	-	-	-	-	-	-	-	-	-	-
Shoot fw	1st	0.58*	0.53*	0.66*	0.32	-	-	-	-	-	-	-	-	-
	2nd	0.46*	0.36	0.51*	0.41*	-	-	-	-	-	-	-	-	-
Shoot dw	1st	0.37	0.34	0.57*	0.54*	0.77*	-	-	-	-	-	-	-	-
	2nd	0.11	0.33	0.24	0.60*	0.80*	-	-	-	-	-	-	-	-
Root fw	1st	0.29	0.42*	0.57*	0.31	0.66*	0.67*	-	-	-	-	-	-	-
	2nd	0.14	0.24	0.15	0.35	0.54*	0.63*	-	-	-	-	-	-	-
Root dw	1st	0.21	0.27	0.56*	0.46*	0.61*	0.80*	0.78*	-	-	-	-	-	-
	2nd	0.07	0.39*	0.19	0.45*	0.60*	0.74*	0.77*	-	-	-	-	-	-
Flower number/ plant	1st	0.50*	0.40*	0.57*	0.44*	0.77*	0.73*	0.64*	0.65*	-	-	-	-	-
	2nd	-0.07	-0.01	-0.07	0.35	0.36	0.54*	0.27	0.38*	-	-	-	-	-
Floret number/ flower	1st	0.13	0.04	0.14	0.13	0.08	0.31	0.29	0.41*	0.07	-	-	-	-
	2nd	-0.07	0.02	-0.11	-0.10	0.06	0.25	0.43*	0.41*	0.47*	-	-	-	-
Flower weight	1st	0.48*	0.35	0.38*	0.12	0.40*	0.31	0.31	0.22	0.18	0.26	-	-	-
	2nd	0.16	0.54*	0.45*	-0.05	0.40*	0.41*	0.29	0.24	0.08	0.23	-	-	-
Chlorophyll a	1st	0.18	0.05	0.24	0.42*	0.19	0.46*	0.37	0.49*	0.31	0.18	-0.09	-	-
	2nd	-0.15	0.28	-0.04	0.41*	0.42*	0.65*	0.49*	0.54*	0.47*	0.34	0.48*	-	-
Chlorophyll b	1st	0.06	-0.03	-0.002	0.004	-0.05	0.06	0.18	0.27	-0.002	0.01	-0.13	0.67*	-
	2nd	-0.01	0.32	0.17	0.23	0.25	0.33	0.36	0.45*	0.17	0.21	0.36	0.68*	-
Carotenoids	1st	-0.49*	-0.41*	-0.25	0.17	-0.29	-0.15	-0.23	-0.05	-0.28	0.10	-0.32	0.08	0.17
	2nd	-0.46*	0.10	-0.35	0.15	-0.06	-0.01	-0.02	0.21	0.21	-0.06	-0.19	0.09	0.20

*** Significant at $p \leq 0.0$**

To interpret these results, the effect of SA on plant functions should be understood. SA is involved in regulating plant growth processes as reported by previous studies such as Singh (1993) who demonstrated the effect of SA in stimulating of root formation in young shoots of ornamental plants. Spraying SA at the flowering stages of cotton increased boll numbers as shown by Hampton and Oosterhuis (1990). This positive effect could be explained upon the effect of SA on increasing CO2 assimilation and accordingly photosynthetic rate in addition to the increase in mineral uptake (Karlidage *et al*. 2009). Another explanation for the positive effect of SA on growth and yield could be its influence on other plant hormones which play a fundamental role in the auxin, cytokinin and ABA balances (Shakirova, 2007).

The current experiment showed a significant increase in plant height in SA-treated plants over the control treatment. Nagasubramaniam *et al*. (2007) demonstrated that SA treatments increased plant height comparing to the control. Increasing the concentration of SA in our experiment resulted in a significant decrease in plant height. This reduction in plant height with the higher concentrations of SA was clearly compensated by a significant increase in leaf area and plant fresh and dry biomass. These results are supported by the findings of Pancheva *et al*. (1996) who reported that growth of barley seedling leaves and roots decreased when plants were treated with SA, with a stronger effect observed when the concentration of SA was increased.

CONCLUSIONS

The enhancement of vegetative and flowering growth characteristics of Ixora, as an amazing flowering pot plant, was induced by the foliar application of either SA or GA_3. Four concentrations from each of SA and GA_3 were used in the current experiment, the best of which were 400 ppm GA_3 and 300 or 400 ppm of SA. In general, GA_3 was superior in improving growth and flowering quality of Ixora. Accordingly, to get more compact plants bearing bigger leaves and high quality flowers to be sued as pot plants, it's advised to spray Ixora plants with SA at either 300 or 400 ppm. Meanwhile, to produce plants with taller shoots useful for getting more cuttings, in addition to more flowers with high quality, GA_3 at 400 ppm is recommended.

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المعاملة بالرش الورقي بكل من حمضي السالسيليك والجبريليك تحسن من نمو وإزهار نباتات الإكزورا

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تهدف التجربة الحالية إلى اختبار تأثير المعاملة بالرش الورقي بكل من حمضي السالسيليك والجبريليك على نمو وإزهار نباتات الإكزورا. حيث تم معاملة النباتات بالرش بأربع تركيزات (١٠٠، ٢٠٠، ٣٠٠ و ٤٠٠ جزء في المليون) من كل من حمضى السالسيليك والجبريليك بالإضافة إلى المعاملة الكنترول (الرش بالماء). وأظهرت النتائج تحسناً في جميع الصفات الخضرية والزهرية للنباتات كنتيجة للمعاملة بأي من التركيزات المستخدمة مقارنة بالكنترول. كما أعطى أقل تركيز من حمض السالسيليك (١٠٠ جزء في المليون) أكثر النباتات ارتفاعاً في حين أدت المعاملة بتركيز ٢٠٠ جزء في المليون إلى زيادة في مساحة الأوراق ونسبة السيقان إلى الجذور. ولوحظت زيادة معنوية في عدد الأوراق ومحتواها من الكلوروفيل أ ، ب والكاروتينويدات كنتيجة للمعاملة بتركيز ٣٠٠ جزء في المليون من السالسيليك ، في حين أدت المعاملة بتركيز ٤٠٠ جزء في المليون إلى زيادة في الوزن الطازج والجاف للسيقان والجذور وكذلك عدد الأزهار. وبخصوص المعاملة بالجبريليك، فقد أدت المعاملة بتركيز ٣٠٠ أو ٤٠٠ جزء في المليون إلى زيادة معنوية في معظم صفات النمو للنبات المعاملة مقارنة بالكنترول. كما كانت قيمة معامل الارتباط معنوية بين معظم صفات النمو الخضري وبين صفات النمو الزهري للنباتات.