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Improvement the Productivity and Quality of *Pelargonium*× *hortorum* L. Plants by Using Potassium Iodide Applications

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IODINE HAS considered as a trace beneficial element for higher plants and it has long been recognized as an important element environmentally. In order to study the effects of different application methods (foliar spray, soil application or foliar combined with soil application) of potassium iodide (KI) at 2, 4, 6 or 8 mg L^{-1} on vegetative growth and some physiological characteristics of Zonal pelargonium (*Pelargonium* × *hortorum* L.*)* plants, a pot experiment was carried out during 2017 and 2018 at AL Mansoura Horticulture Research Station, Horticulture Research Institute, Agriculture Research Center, Egypt. The study showed that generally all different applications had positive effects on the vegetative growth and inflorescence parameters except foliar application at 2 mg L^{-1} concentration. Soil application at 2, 4 or 6 mg L^{-1} showed the highest values of shoot length, number of branches and fresh and dry weight. Soil combined with foliar applications at 6mg L^{-1}gave the highest number and neck length of inflorescences per plant. Additionally, the same application method at 4mg L^{-1} resulted in the highest diameter of inflorescences.All used iodine treatments increased significantly nitrogen, phosphorus and total sugars in pelargonium plants over control while, the total polyphenols content of pelargonium plants was decreased in comparison to control plants.The results refer to the possibility of using KI as soil application for improved the productivity and quality of pelargonium plants.

Keywords: Pelargonium plants, Potassium iodide, Foliar application, Soil application, Inflorescence parameters.

Introduction

Zonal pelargonium (*Pelargonium* × *hortorum* L., family Geraniaceae) is a perennial evergreen, mostly grows naturally in tropical, subtropical and Mediterranean climates. Pelargonium is the most important summer flowering ornamental plant using in landscape design. It's extremely popular using as bedding plants in landscape, decoration of windows, balconies, terraces and roof gardens. Pelargonium plants were the most popular garden plants. Sales of garden plants increased in the Dutch market by 9.3% from 2016 to 2017, and the pelargonium plants ranked sixth by 19 million units sold at 13 million euro (Flora Holland annual report, 2017). This arrangement indicates the great economic importance of the pelargonium plants in Europe. To maximize growth and quality of pelargonium, the fertilization during production is extremely important. So, the looking for low cost fertilizers is a must now.

Iodine (I) is a trace element and distributed into the atmosphere and land areas from the oceans which considered as the largest reservoirs of bioavailable iodine on the planet (Venturi, 2011). The second largest reservoir of iodine is the soil (Muramatsu and Yoshida, 1999). Iodine in the form of gas and aerosol is carried by the wind and rain to land areas, where it is found in soil mostly in two forms: iodide (I^-) and iodate (IO_3^-) (Medrano-Macías et al., 2016). In soil, iodine is spreaded in several ways: evaporate into the atmosphere by abiotic and biotic processes, fixed in soil and biomass, or backed to the oceans through water streams (Moreda-Piñeiro et al., 2011, Saunders et al., 2012 and Fuge & Johnson, 2015). Iodine considered as non-essential element for higher plants, although all plants can assimilate it from soil. Iodine in humus and clay soils is fixed by organic substances and aluminium and iron oxides. So, the plants grown in the soils which contains organic matters have a low iodine content (Jopke et al., 1996).

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Iodide has considerable bioavailability for plants comparing with iodate (Whitehead, 1973). Iodine content in the plant significantly increased with increasing in iodine concentration and was up to five times higher with I^- than with IO_3^- (Voogt et al., 2010). Iodine treatment contributed to increase the P, K and Ca contents of carrot roots (Smolen et al., 2011).

The highly cost of factorial fertilizers for production of ornamental plants led to search for low cost nutrition as an alternative. So, the aim of this study was to assess the influence of application methods with potassium iodide (KI) on production and quality of Zonal pelargonium.

Materials and Methods

Plant material and experimental design

A pot experiment was conducted at AL Mansoura Horticulture Research Station, Horticulture Research Institute, Agriculture Research Center, Egypt, during 2017 and 2018 seasons. Terminal cuttings (8±1cm long) were obtained from *Zonal pelargonium* (*Pelargonium* × *hortorum* L.), two years old, at 7th January and planted in plastic pots (15cm in diameter) filled with a mixture ofsand and clay soilat 2:1 vol.:vol.(a single cutting/pot). A random soil sample was collected from the soil mixture before the beginning of the treatments and was air-dried, ground and sieved over a 2mm-sieve. Physico-chemical properties were carried out as the following: distribution of particle size by using the pipette method as described by Dewis and Fertias (1970), electrical conductivity and the soil pH of saturated soil paste extract according to Jackson (1967) and Richards (1954). Data of soil analysis was presented in Table 1. Cuttings were transplanted at one month age into plastic pots (25cm in diameter) filled with the same soil mixture and remained till the end of the experiment. Plants were not received any fertilizers along the experimental period and watered once time a week during the initial three months of the experiment and 2 times a week during the late three months. The plants were grown under a semi-shade trellis over the experimental period. The experimental design was complete randomized block with three replicates.

Potassium Iodide treatments

Potassium iodide (KI) was purchased from Al-Gomhorya Pharmaceutical Company, Mansoura branch, Egypt. Plants were treated with KI in five times with one month intervals. The first addition of KI treatments was at 21stday after planting cuttings by three methods: foliar spray, soil applicationor combined foliar with soil application at 4 concentrations: 2, 4, 6, and 8 mg L^{-1}. Distilled water was used for preparing the KI solutions supplement with 0.02% Tween 20, (polyoxyethylenesorbitan monolaurate), as a surfactant to improve spreading and sticking properties. Plants treated with KI as spraying method were done manually by using spraying bottle until it flooded on the plants while plant treated as soil application were done by add a 100ml/pot of KI solutions as soil drench. The pot ground surface of spraying treatments was covered with foil paper to prevent any solution to drop to the soil. Control plants (zero KI concentrate) were sprayed with distilled water.

Vegetative parameters were measured at the end of the experiment (at 4 months after transplanting) and included: plant height, number of branches/plant, and shoot fresh and dry weights.

Inflorescences characteristics were begun to measure at the inflorescences stage after thirty days of transplanting, when at least two inflorescences were blooming. Inflorescences parameters were included: number of inflorescences/plant, diameter of inflorescences, and theinflorescences neck length. Inflorescences were counted every week until the end of the experiment and they were removed after falling approximately 70% of florets.

Physiological measurements were done at the end of the experiment. Randomly fully mature leaves were taken from three plants per replicate to estimate the total chlorophyll and carotenoids contents (mg/g fresh weight) according to Lichtenthaler and Wellburn (1983). Nitrogen, phosphorus and potassium were determined according to the Association of Official Analytical Chemists (A.0.A.C, 1990), Olsen and Sommers (1982) and Jackson (1967) respectively. Total sugars content was measured per gram dry weight according to Dubioset al. (1956). Total polyphenol contents (TPC) were determined using the Folin-Ciocalteu method according to Li et al.(2007), where, gallic acid was used as a standard and total polyphenols content were expressed as mg gallic per gram dry extract.

Statistical analysis

The data were analyzed by one-way ANOVA using the analysis of variance technique by means of CoStat Computer Software (Cohort, Berkeley, CA,USA). Mean values were compared by using

TABLE 1. Physico-chemical properties of the experimental soil (averaged over two seasons).

Physical properties										
Sand (%)	Clay (%)	Silt (%)	Soil texture				Field capacity (%)			
59.2	27.2	13.6	Sandy loam				19.13			
Chemical properties										
pH 1:2.5H_2O	EC (dSm^1)	$CaCO_3$ (%)	Cations (meq L-1)				Anions (meq L^{-1})			
			K^+	Mg^{++}	Ca^{++}	Na^+	Cl^-	Hco_3^-	Co_3^-	So_4^-
7.81	1.87	2.54	0.189	1.75	2.31	1.57	0.98	0.44	-	0.96
Available nutrients										
Macronutrients (mg/100g)				Micronutrients (ppm)						
Total N	P	K	**Mn**	**Fe**	Zn	Cu				
11.4	9.6	17.9	**1.93**	**3.37**	1.08	3				

Duncan's multiple range test method as mentioned by Gomez and Gomez (1984) at least significance difference ($p \leq 0.05$).

Results

Vegetative growth parameters

From this investigation, it is clear that the impact of iodine in foliar, soil and foliar combined with soil application methods on vegetative growth traits had significanteffects in comparison to the control plants. The highest increasing in shoot length and fresh and dry weight were done by soil application at 4 and 6 mg L^{-1} in both seasons (Table 2). Additionally, the highest values in number of branches/plant were significantly

TABLE 2. Shoot length, number of branches/plant and fresh and dryweight/plant in*Pelargonium×hortorum*as affected by different application methods and concentrationsof potassium iodide (KI) during the twoseasons (2017 and 2018).

Parameters	Shoot length (cm)		No. branches/plant		Plant fresh weight (g)		Plant dry weight (g)	
Treatments (KI application)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	25.00f	22.00g	1.33d	1.33f	22.32ef	21.45d	2.68gh	2.66e
Foliar application at 2 mg L^{-1}	21.17g	20.00h	1.67d	1.67f	13.45h	14.45e	2.21h	2.51e
Foliar application at 4 mg L^{-1}	24.67f	23.33g	4.00bc	3.33de	14.67gh	14.80e	2.30h	2.62e
Foliar application at 6 mg L^{-1}	38.00b	34.00de	3.67bc	2.67ef	25.49de	27.11c	4.17ef	4.02cd
Foliar application at 8 mg L^{-1}	33.50d	34.17de	6.67a	7.00a	39.25c	37.22b	5.95bc	5.76a
Soil application at 2 mg L^{-1}	37.83b	38.67b	4.67b	6.33ab	44.97b	44.33a	5.84bcd	5.51a
Soil application at 4 mg L^{-1}	43.00a	35.50cd	4.67b	5.00bc	52.47a	42.68a	6.57ab	4.55bc
Soil application at 6 mg L^{-1}	43.50a	41.33a	4.00bc	4.67cd	47.90ab	37.47b	7.13a	5.56a
Soil application at 8 mg L^{-1}	35.00c	34.83de	3.33c	2.67ef	27.60de	28.63c	4.27ef	4.53bc
Foliar + soil at 2 mg L^{-1}	37.50b	36.67c	4.00bc	3.67cde	38.12c	34.49b	5.74bcd	5.15ab
Foliar + soil at 4 mg L^{-1}	37.17b	35.50cd	3.00c	3.33de	35.10c	35.42b	4.72de	3.86cd
Foliar + soil at 6 mg L^{-1}	33.00d	33.17e	4.00bc	5.00bc	28.80d	27.29c	5.09cde	4.95ab
Foliar + soil at 8 mg L^{-1}	28.00e	28.50f	3.33c	2.33ef	19.30fg	19.34d	3.46fg	3.31de

Mean values followed by the same letter in each column do not differ significantly at P≤0.05 based onDuncan's multiple range test.

recorded with foliar application at 8 mg L^{-1}(6.67 and 7.00 branches/plant, respectively in both seasons).

Moreover, the combinations between foliar and soil application methods at concentrations of 2, 4 and 6 mg L^{-1} significantly increased the vegetative growth parameters comparing with the control plants. Foliar application with low concentration of KI (2 mg L^{-1}) significantly decreased the vegetative growth parameters in the both seasons.

Inflorescence parameters

In the context of presented data, it should be underlined that different application methodsof KI at all concentrations ,generally, increased the number of Inflorescences and neck length and diameter of Inflorescences when compared to the control plants except, when plants sprayed with KI at 2 and 4 mg L-1 which were not significantly during the two seasons (Table 3). Another exception, soil application with KI at 8 mg L-1or combined with foliar application at the same concentration did not affect the neck length and diameter of Inflorescences in comparison to the control plants. The highest number of Inflorescences was obtained by the combination between the foliar and soil application at 6 mg L-1 (17.67 and 17.00 Inflorescences/plant, respectively in both seasons). Moreover, the largest Inflorescence diameter was resulted from the combination between spraying plants and soil application with KI at 4 mg L-1 concentration.

TABLE 3. Inflorescenceparametersin *Pelargonium* × *hortorum*as affected by different application methods and concentrations of potassium iodide (KI) during the two seasons (2017 and 2018).

Parameters	No. inflorescences /plant		Inflorescence neck length (cm)		Inflorescence diameter(cm)	
Treatments (KI application)	**1st season**	**2nd season**	**1st season**	**2nd season**	**1st season**	**2nd season**
Control	7.00g	7.67ef	8.40f	8.73g	6.20f	6.00ef
Foliar application at 2 mg L^{-1}	7.00g	6.33f	7.10h	7.60h	5.60gh	6.23def
Foliar application at 4 mg L^{-1}	7.00g	8.33e	8.13fg	7.10i	6.80e	6.27def
Foliar application at 6 mg L^{-1}	12.00de	11.0d	12.50c	10.23f	7.60d	6.50de
Foliar application at 8 mg L^{-1}	11.00ef	12.33bcd	10.50e	10.00f	9.00b	8.83b
Soil application at 2 mg L^{-1}	15.00b	16.33a	15.00b	14.00c	9.00b	10.00a
Soil application at 4 mg L^{-1}	14.00bc	12.67bcd	16.00a	14.37bc	7.00e	6.60d
Soil application at 6 mg L^{-1}	14.00bc	14.00b	12.17c	11.00e	8.50c	8.00c
Soil application at 8 mg L^{-1}	10.00f	11.33d	6.00i	6.80i	6.00fg	5.40g
Foliar + soil at 2 mg L^{-1}	15.00b	13.67bc	11.50d	15.50a	7.00e	8.00c
Foliar + soil at 4 mg L^{-1}	8.00g	8.00ef	15.00b	13.00d	10.00a	8.50bc
Foliar + soil at 6 mg L^{-1}	17.67a	17.00a	16.00a	14.60b	8.00d	8.00c
Foliar + soil at 8 mg L^{-1}	13.00cd	12.00cd	7.63gh	7.90h	5.50h	5.77fg

Mean values followed by the same letter in each column do not differ significantly at P≤0.05 based on Duncan's multiple range test.

Physiological parameters

Effects of KI applications on total chlorophyll and carotenoid contents

Data in Table 4, evidently, reveal a variance of effects of KI at all concentrations and at all application methods on total chlorophyll content of pelargonium plants. It is clearly that plants received KI at 8 mg L^{-1} as foliar application and at 4 or 8 mg L^{-1} as soil application, were increased in total chlorophyll contents. The lowest value of total chlorophyll was induced with KI foliar spray at 6 mg L^{-1}. Concerning the effect of KI application on carotenoids content, data in

TABLE 4. Total chlorophyll and carotenoids (mg g^{-1} fresh weight) in *Pelargonium× Hortorum*as affected by different application methods and concentrations of potassium iodide (KI) during the two seasons (2017 and 2018).

Parameters	Total chlorophyll (mg g^{-1} fresh weight)		Total carotenoids (mg g^{-1} fresh weight)	
Treatments (KI application)	**1st season**	**2nd season**	**1st season**	**2nd season**
Control	1.49c	1.64efg	0.027e	0.028de
Foliar application at 2 mg L^{-1}	1.24d	1.51g	0.034de	0.038c
Foliar application at 4 mg L^{-1}	1.75b	1.75de	0.059ab	0.032cde
Foliar application at 6 mg L^{-1}	1.53c	1.56fg	0.048bcd	0.034cd
Foliar application at 8 mg L^{-1}	2.19a	2.02ab	0.027e	0.025e
Soil application at 2 mg L^{-1}	1.61bc	1.80cde	0.049bc	0.034cd
Soil application at 4 mg L^{-1}	2.22a	1.91bcd	0.033e	0.027de
Soil application at 6 mg L^{-1}	2.36a	2.11a	0.027e	0.034cd
Soil application at 8 mg L^{-1}	1.55bc	1.69ef	0.071a	0.065a
Foliar + soil at 2 mg L^{-1}	1.64bc	1.96abc	0.064a	0.037c
Foliar + soil at 4 mg L^{-1}	1.66bc	1.51g	0.058ab	0.053b
Foliar + soil at 6 mg L^{-1}	1.74b	1.81cde	0.036cde	0.048b
Foliar + soil at 8 mg L^{-1}	1.54c	1.79cde	0.041cde	0.050b

Mean values followed by the same letter in each column do not differ significantly at P≤0.05 based on Duncan's multiplerange test.

Table 4 reveal that plants treated with all KI treatments led to increase the carotenoids content comparing to the control plants except that the 8ppm concentration as foliar or soil application were not significant.

Effects of KI applications on nitrogen, phosphorus and potassium contents

Regarding the effect of treated plants with KI on N, P and K contents, Table 5 shows that KI application methods at all concentrations, in general, led to greatly increase in N and P elements concentration in pelargonium shoots. Spraying plant at 6 mg L^{-1} gave the highest nitrogen percentage (2.709% & 2.748% respectively in both seasons) followed by soil application at 4 mg L^{-1} (2.661%) during the first season andby foliar application at 4 mg L^{-1} (2.549%) during the second season. Plants sprayed with KI at 2 mg L^{-1}had lowest nitrogen content during the first season. The phosphorus and potassium contents in pelargonium shoots were varied in response to KI application methods. Soil application method at 6 mg L^{-1} significantly led to highly increasing the P% concentration during the both seasons. The potassium content in plant shoots

TABLE 5. Nitrogen, phosphorus and potassium contents in*Pelargonium*× *hortorum*as affected by different application methods and concentrationsof potassium iodide (KI) during the two seasons (2017 and 2018).

Treatments	N %		P %		K %	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	2.220i	2.285h	0.321g	0.330h	2.494c	2.458b
Foliar application at 2 mg L^{-1}	2.036l	2.213j	0.333e	0.362b	2.056k	2.041i
Foliar application at 4 mg L^{-1}	2.218j	2.549b	0.330f	0.342e	2.076j	2.043i
Foliar application at 6 mg L^{-1}	2.709a	2.748a	0.258l	0.260j	2.122h	2.015j
Foliar application at 8 mg L^{-1}	2.618c	2.411d	0.314h	0.338f	2.316e	2.287d
Soil application at 2 mg L^{-1}	2.590d	2.250i	0.342c	0.331h	2.291f	2.139f
Soil application at 4 mg L^{-1}	2.661b	2.301g	0.360b	0.384a	2.772a	2.596a
Soil application at 6 mg L^{-1}	2.423h	2.340f	0.364a	0.357c	2.579b	2.213e
Soil application at 8 mg L^{-1}	2.493f	2.509c	0.289k	0.219k	2.092i	2.057h
Foliar + soil at 2 mg L^{-1}	2.576e	2.508c	0.308i	0.288i	1.885m	1.644l
Foliar + soil at 4 mg L^{-1}	2.433g	2.245i	0.336d	0.341e	2.142g	2.108g
Foliar + soil at 6 mg L^{-1}	2.235i	2.369e	0.320g	0.335g	2.424d	2.308c
Foliar + soil at 8 mg L^{-1}	2.097k	2.117k	0.305j	0.350d	1.926l	1.884k

Mean values followed by the same letter in each column do not differ significantly at P≤0.05 based on Duncan's multiple range test.

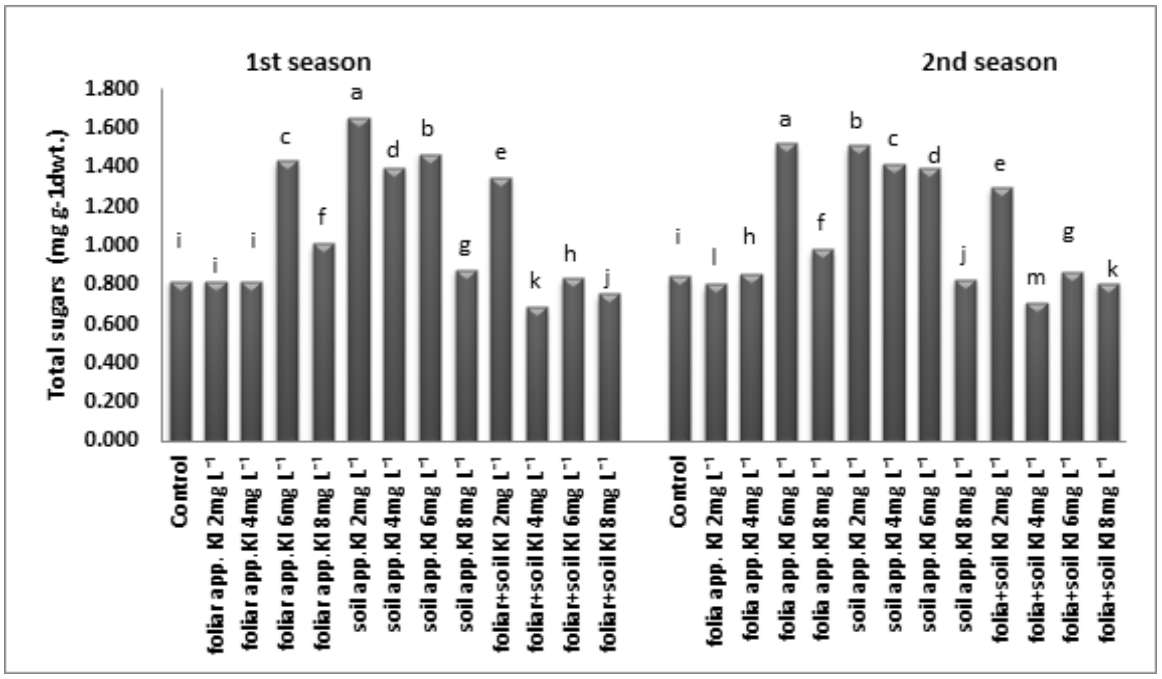
significantly increased by soil application with KI at 4 mg L^{-1} during the both seasons (2.772% & 2.596% respectively). Particularly interesting is the fact that spraying method with KI at 2mg L^{-1} diminished the NPK content of pelargonium plants.

Effects of KI applications on total sugar contents

Total sugars were significantly influenced by the treatment of KI during both seasons (Fig. 1). Soil application of KI at 2, 4 and 6 mg L^{-1} significantly gave the highest values of total sugars comparing with the other application methods. Also, thetotal sugars contents increasedwhen sprayingplants either with 6 or 8 mg L^{-1} concentration in comparison to control plants.Plants treated by soil application combined with spraying plants with KI at 4 mg L^{-1} led to reduce the total sugar contents.

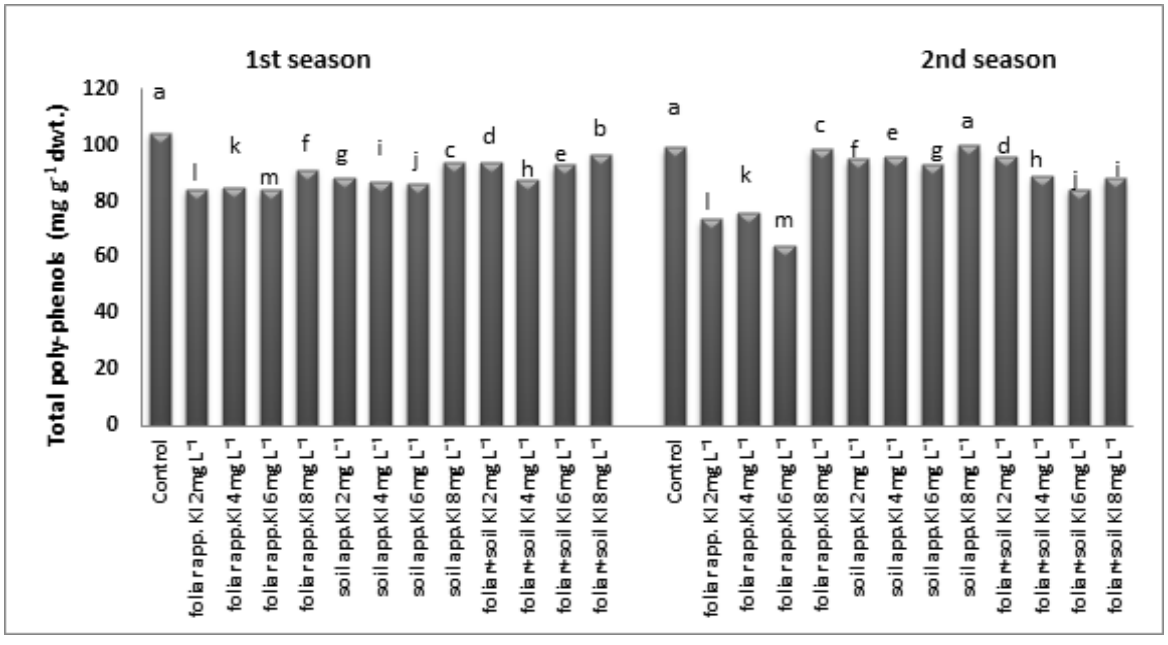
Effects of KI applications on total poly-phenols contents

Total poly-phenol compounds along all treatments were decreased comparing with the control plants during the two seasons (Fig. 2). In comparison between the three methods



Mean values followed by the same letter in each season do not differ significantly at P≤0.05 based on Duncan's multiple range test.

Fig. 1. Total sugars content (mg g-1dwt.) in Pelargonium × hortorumas affected by different application methods and concentrations of potassium iodide (KI) during the two seasons (2017 and 2018).



Mean values followed by the same letter in each season do not differ significantly at P≤0.05 based on Duncan's multiple range test.

Fig. 2. Total poly-phenols content inPelargonium × hortorum as affected by different application methods and concentrations.

of applications, the soil combined with foliar application treatment at 8 mg L^{-1}recorded the highest value of phenols (96.69mg g^{-1}dwt.) during the first season while soil application at 8mg L^{-1} gave the highest content of poly-phenols (99.84mg g^{-1}dwt.) during the second season.

Discussion

The present investigation demonstrated that KI nutrition had mostly positive effects on the pelargonium vegetative growth and physiological parameters. The trials presented here clearly indicated that the shoot length, number of branches and fresh and dry weights as well as the inflorescence characterize were much greater with the soil application method than the foliar application. Accordantly to the previous results obtained in the biofortification with KI, the growth of some plants (e.g. perennial ryegrass, tomatoes, spinach) was significantly activated by iodine application to the growth environment (Borst Pauwels,1961). Also, the results acquired in this investigation would be in conformity with the previous results on some vegetable species (i.e. Landini et al., 2011 on tomato and Lawson et al., 2015 on lettuce). Biofortification had more effectiveness with increasing iodine doses (Blasco et al. 2008 and Weng et al. 2008). In agreement with that, the results obtained from this investigation indicated that pelargonium plants have an adverse response in the growth and inflorescence parameters when sprayed with KI at the lowest concentration (2 mg L^{-1}). Concerning the influence of KI on increasing the plant biomass of this investigation,it may be attributed to the impact of KI on nitrogen absorption and metabolism in plants. The increasing ofN, P, and K concentrations in pelargonium plants obtained in this study may be attributed to the influence of KI on increasing the easily soluble forms of these elements in soil (Smolen et al. 2011) and this observation can indirectly induced a positive effects of iodine in improved plant growth and yielding (Kabata-Pendias and Mukherjee, 2007). Smolen and sady (2011a) stated that the soil application of iodine contributed to increase the nitrogen mineral ($N\text{-}NO_3$) level in soil what was moreover reflected in improved nitrogen nutrition of spinach. They added that biofortification with KI may enhanced the growth and development of microorganisms responsible for mineralization of soil organic matter, resulted in increasing the amount of mineral nitrogen released in this process and improved the nitrogen uptake by plants as well as increasing the nitrogen-utilization efficiency (Blasco et al. 2011). Iodine in general affects nitrogen metabolism in plants. Nevertheless, iodine impact on macronutrients uptake by plants depends on many factors, including: iodine form, dose and method of application and also it affected by conditions of crop cultivation and genotypic variation of plants in the ability towards particular speciation of elements taken from soil (Smolen and Sady, 2011b).

The results obtained from this investigation clearly indicated that KI resulted to a relatively increasing the total sugars and decreasing the total phenols in all treated planted. Smolen and sady (2011a) stated that iodine significantly did not affect the level of phenolic compounds in spinach. In contrary, Blasco et al.(2008) reported an increasing in accumulation of phenols and ascorbic acid, as well as antioxidant potential with KI treatments in lettuce grown in hydroponics.

Concerning to the adverse responses in all parameters of pelargonium plants which treated with the highest concentration of KI (8 mg L^{-1}) as foliar combined with ground applications may be attributed to the toxic effects of KI on plants. Singh et al. (2012) stated that higher concentration of KI led to drastically decrease the plant height of rice. Lawson et al. (2015) reported that the phytotoxic symptoms on older leaves of lettuce were observed in the very early developmental stage when the highest KI dose was applied and they were indicated to their little known about the mechanism of iodide toxicity in plants. However, Mynett and Wain (1973) reported that KI may arise from intracellular oxidation of iodide to elemental iodine followed by iodination of cellular components, including chlorophyll.

Conclusion

Generally, the results obtained from this investigation reveal that KI application enhanced the vegetative growth and flowering characters and some physiological parameters except total phenolic compounds of pelargonium plants when it applied as soil application at all tested concentrations (2,4,6 and 8 mg L^{-1}) and also when applied as foliar application at 6 and 8 mg L^{-1}. Certainly, the soil application of KI has the advantage for increasing the nutrients availability and efficiency use of the pelargonium plants and will be a good idea for the promotion of plant growth criteria in sustainable agricultural

production systems especially on the times of the extremely high nutrients cost. However, the recommendation of the suggested idea to the iodine fertilization needs further studies to trace the effects of KI application on the ornamental plant growth.

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Conflicts of interest
No conflicts of interest to declare.

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تحسين إنتاج وجودة نباتات الجارونيا باستخدام يوديد البوتاسيوم

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يعتبر اليود عنصراً مفيداً للنباتات الراقية وقد تم الإعتراف به منذ فترة طويلة كعنصر مهم بيئياً. لدراسة تأثير الطرق المختلفة لإضافة يوديد البوتاسيوم (الرش الورقى, الإضافة الأرضية , الرش الورقى مع الإضافة الأرضية) بتركيز ٢, ٤, ٦, ٨ مللى جرام/لتر على النمو الخضرى والصفات الزهرية وبعض الصفات الفسيولوجية على نباتات الجارونيا, أجريت تجربة أصص خلال موسمى ٢٠١٦ و ٢٠١٧ فى محطة بحوث البساتين بالمنصورة, معهد بحوث البساتين, مركز البحوث الزراعية. وقد بينت الدراسة أن الإضافات الأرضية فى العموم كانت ذات تأثيرات إيجابية على النمو الخضرى والصفات الزهرية. الإضافة الأرضية ليوديد البوتاسيوم عند تركيز ٢, ٤, ٦ مللى جرام/لتر أعطت أعلى القيم لإرتفاع النبات وعدد الأفرع والوزن الطازج والجاف. الرش الورقى مع الإضافة الأرضية عند تركيز ٦مللى جرام/لتر أعطى أعلى عدد للنورات الزهرية وأطول طول لعنق النورة الزهرية. أيضاً نفس المعاملة عند تركيز ٤ مللى جرام/لتر أعطت أعلى قطر للنورات الزهرية. أدى الرش الورقى عند تركيز ٢ مللى جرام/لتر إلى تأثير سلبى على نباتات الجارونيا. أدت التطبيقات الأرضية مع الرش الورقى إلى زيادة محتوى النبات من النيتروجين والفوسفور والسكريات الكلية. جميع معاملات اليود أدت إلى نقص محتوى الجارونيا من الفينولات الكلية.تشير النتائج إلى إمكانية إستخدام KI كإضافة أرضية لتحسين إنتاجية وجودة نباتات الجارونيا.