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Response of Vegetative Growth and Some Chemical Constituents of *Syngonium podophyllum* L. To Foliar Application of Thiamine, Ascorbic Acid and Kinetin at Nubaria

Nahed G. Abd El-Aziz, Fatma E.M. El-Quesni and M.M. Farahat

Department of Ornamental Plants and Woody Trees, National Research Centre, Dokki, Cairo, Egypt

Abstract: Pot experiment was carried out in two seasons (2005 and 2006) at National Research Centre, Dokki, Cairo, Egypt, Research and Production Station, Nubaria. To study the effect of foliar application of thiamine (50, 100 ppm), ascorbic acid (50, 100 ppm) and kinetin (20, 40 ppm) in addition to untreated plants as control on vegetative growth and some chemical constituents of *Syngonium podophyllum* L. plants. Foliar application of all treatments significantly promoted all growth parameters compared untreated plants. Foliar application of 50 ppm thiamine, 100 ppm ascorbic acid and 40 ppm kinetin to syngonium plants significantly promoted plant height, number of leaves, stem diameter, leaf area, fresh and dry weights of plant, as well as chemical constituents, than that other treatments. The highest values were obtained in plants treated with 100 ppm ascorbic acid, 50 ppm thiamine and 40 ppm kinetin, respectively. Foliar application of the mentioned treatments to syngonium plant gave the highest levels of photosynthetic pigments, total carbohydrate content. Ascorbic acid at 100 ppm was the most effective treatment in increasing nitrogen, phosphours and potassium contents of the plants, followed by the treatment of 50 ppm thiamine. Foliar application of kinetin (20 and 40 ppm) resulted in the lowest nitrogen content compared with other treatments. On the other hand, kinetin (20 and 40 ppm) increased phosphorus and potassium contents than that of untreated plants.

Key words: *Syngonium Podophyllum* L. Thiamine · Ascorbic Acid · Kinetin

INTRODUCTION

Genus syngonium includes thirty three species, native to tropical South America (Mexico, Panama, El-Salvador, Guatemala, Brazil, Honduras) and Africa. *Syngonium podophyllum* L., commenly known arrowhead plant is the one of the most well known and versatile foliage plant. It is grown widely at South America and African evergreen, syngonium is commenly used as hanging baskets, if upright growth is desired, a totem, trellis or other support is needed, otherwise plants can be used as ground covers. The plants can be used in various places such as offices, hospitals, shops, windows, conference rooms, commercials premises and hotels.Family Araceae, {it is perennial, evergreen and herbaceous vine, it is recognized by its juvenile leaves, which are simple, alternatly arranged and saggitate in shape approximately (7-17.5cm long)}.

Vitamins could be considered as bio-regulators compounds which in little concentration exerted a profound influence upon plant growth, Abdel-Halim [1], Tarraf *et al.* [2] and Gamal El-Din [3] reported that foliar application of thiamine on tomato, lemongrass and sunflower plants increased vegetative growth, total carbohydrate and total nitrogen. Youssef and Talaat [4], reported that foliar application with thiamine enhanced plant growth of rosemary, the regulatory effect of thiamine on the meristem and plant growth and development indirectly throught enhancing the endogenous level of various growth factors as cytokinins and gibberellins. Thiamine (vitamin B_1) is a necessary ingredient for the biosynthesis of the co-enzyme thiamine pyrophosphate, in this latter form it plays an important role in carbohydrate metabolism. It is an essential nutrient for plants, it is synthesized in the leaves and in transported to the roots where it controls, [5]. Blokhina *et al.* [6] stated that ascorbic acid is the most abundant antioxidant which protect plant cells. Ascorbic acid is currently considered to be regulators on plant growth and development owing to their effects on cell division and differentiation and added that ascorbic acid to be involved in wide range of important functions as antioxidant defence, photoprotection and regulation of photosynthesis and growth regulation. Tarraf *et al.* [2] on lemongrass

Corresponding Author: Nahed G. Abd El-Aziz, Department of Ornamental Plants and Woody Trees, National Research Centre, Dokki, Cairo, Egypt

found that application of 50 mg L^{-1}. ascorbic acid had positive effects on growth parameters and increased carbohydrates and total nitrogen percent. Talaat [7] on sweet pepper detected that foliar application of ascorbic acid increased the content of macronutrients (N, P and K).

Ascorbic acid (vitamin C) is known as a growth regulating factor which influences many biological process. Price [8] reported that ascorbic acid increased nuclic acid content, Robinson [9] reported that ascorbic acid acts as a co-enzyme in the enzymatic reactions by which carbohydrates, proteins are metabolized and involved in photosynthesis and respiration. Al-Badawy *et al.* [10] reported that the application of kinetin to *Matricaria chamomilla* plants increased all growth parameters, further support came from the results of Youssef *et al.* [11] who stated that kinetin (20, 40 ppm) caused considerable increases in plant height, fresh and dry weights of leaves and branches of ornamental plants and added that application of kinetin to *Matthiola incana* plants increased significantly chl a,b and total carbohydrates and added that protein content was increased due to kinetin foliar application. Cytokinins are important plant hormones that regulate various processes of plant growth and development including cell division and differentiation, enhancement of leaf expansion and nutrient mobilization [12, 13].

Therefore, the present investigation aims to study the effect of thiamine, ascorbic acid and kinetin on growth and chemical constituents of syngonium plants substances.

MATERIALS AND METHODS

The experimental trails were carried out at National Research Center (Research and Production Station, Nubaria). On 1st February 2005, 2006 seasons, vegetative uniform cuttings (15-20 cm length) were taken from syngonium plants, cuttings were treated for one minute with 1000 mg L^{-1}. indole butric acid before planting in pots to enhance rooting. Rooted cutting were planted in black plastic pots 10cm in diameter (one plant /pot) and grown in shaded greenhouse media formulated by combination of peatmoss and sandy soil (1:1, V/V) with pH 5.5 to 6.5 and humidity about 60 to 80%, a nutrient solution with (3N: $1P_2O_5$: $2K_2O$) with micronutrients. The seedlings were transplanted on 1st April 2005 and 2006 seasons, in plastic pots 30 cm in diameter filled with 10 kg. of peatmoss and sandy soil (1:1, V/V), arranged in a complete randomized design with three replicates. Each replicate consisted of three plants. Water requirements were relative humidity maintained between 40 and 60%, allow the surface of potting media to dry slightly before irrigation. Each pot was fertilized twice with 1.5 gm. nitrogen as ammonium nitrate (33.5%N) and 1.0 gm. potassium sulphate (48.5% K_2O). The fertilizers were applied at 30 and 60 days after transplanting. Phosphorus as calcium superphosphate (15.5% P_2O_5) was mixed with media before transplanting at a rate of 3.0 gm/pot. Other agricultural processes were performed according to normal practice.

Plants were sprayed with different concentrations of thiamine (50, 100 ppm), ascorbic acid (50, 100 ppm), kinetin (20, 40 ppm) and untreated plants, while sprayed with tap water. Foliar application of thiamine, ascorbic acid and kinetin was carried out twice (30 and 60 days from transplanting) as foliar sprays to cover completely the plant foliage.

The following data were recorded on 30 November 2005 and 2006 seasons: plant height (cm), stem diameter (mm), root length (cm), number of leaves / plant, leaf area (cm^2) of 4 and 5 base leaves, fresh and dry weights (g) of plant organs. Photosynthetic pigments: including chlorophyll (a and b) and caroteniods were determined in exactly 0.1 g of fresh leaves of syngonium plants using the spectrophotometric method developed by Metzzner *et al.* [14]. Total carboyhydrates, were determined in the ground fine powder of syngonium leaves using colorimetric method described by Herbert *et al.* [15]. Total nitrogen was determined by Chapman and Pratt [16] while phosphorus determination was carried out colorimetrically according to King [17]. Potassium was determined photometrically by Flame Photometer method as described by Brown and Lilland [18].

Data obtained were subjected to standard analysis of variance procedure. The values of LSD were obtained whenever F values were significant at 5% level as reported by Snedecor and Cochran [19].

RESULTS AND DISCUSSION

1- Effect of thiamine, ascorbic acid and kinetin on vegetative growth: Data presented in Table 1 elucidate that all treatments used increased all growth parameters of syngonium plants, the highest increments of these parameters were obtained by 50 ppm thiamine and 100 ppm ascorbic acid than that of untreated plants. Concerning the effect of thiamine at the two concentrations, thiamine at 50ppm significantly exceeded plant height, number of leaves/plant and root length by

Table 1: Effect of foliar application of thiamine, ascorbic acid and kinetin on vegetative growth of *Syngonium podophyllum* plants (average of two seasons 2005 and 2006)

Treatment	Concentration ppm	Plant height (cm)	Stem diameter (mm)	Number of leaves/plant	Root length (cm)	Leaf area (cm^2)
Control	0	178.0	13.0	42.3	39.8	44.3
Thiamine	50	203.0	15.0	50.8	54.8	56.2
	100	201.0	17.0	49.7	53.3	58.4
Ascorbic acid	50	193.7	19.0	49.0	57.9	56.2
	100	213.7	14.0	56.0	49.0	63.3
Kinetin	20	175.7	13.3	43.0	35.3	47.3
	40	187.3	14.3	45.0	37.3	55.3
LSD at 5% level		12.0	1.8	3.2	3.90	4.90

Table 2: Effect of foliar application of thiamine, ascorbic acid and kinetin on growth of *Syngonium podophyllum L.* plants (means of two seasons 2005 and 2006)

Treatments	Concentration ppm	Fresh weight of leaves g/plant	Dry weight of leaves g/plant	Fresh weight of stem g/plant	Dry weight of stem g/plant	Fresh weight of roots g/plant	Dry weight of roots g/plant	Fresh weight/ plant g/plant	Dry weight/ plant g/plant
Control	0	57.27	7.00	73.43	11.70	21.23	4.13	151.90	22.83
Thiamine	50	84.97	12.40	87.73	16.33	29.27	6.30	202.00	35.03
	100	78.80	10.87	83.60	14.97	30.43	6.36	192.80	32.20
Ascorbic acid	50	75.90	10.57	80.63	14.03	29.30	6.00	185.80	30.60
	100	86.80	12.43	93.67	17.70	29.17	6.43	209.60	36.97
Kinetin	20	59.23	4.46	75.70	12.50	26.23	5.16	161.20	25.13
	40	61.63	7.93	76.77	12.83	28.33	5.56	166.7	26.33
LSD at 5% level		6.30	1.19	3.12	1.05	2.98	0.60	8.08	1.88

14.0, 20.1 and 37.6%, respectively than the corresponding values of the control plants, while application of thiamine at 100 ppm significantly increased stem diameter and leaf area by 30.7 and 31.8% than control plants, similar conclusions were obtained by Gamal El-Din [3] on sunflower.

It is also quite obvious that foliar application with thiamine and ascorbic acid, significantly increased the number of leaves per plant and leaf area than that of kinetin treatments and control plants in both seasons. Foliar application of ascorbic acid 100 ppm significantly increased plant height, number of leaves/plant and leaf area by 20.1, 32.3 and 42.9% respectively, over control plants, while application of ascorbic acid at 50 ppm significantly increased stem diameter and root length by 46.2 and 45.5%,respectively compared with control plants. These results are in harmony with those obtained by Youssef and Talaat [4], they found that thiamine and ascorbic acid significantly promoted vegetative growth of rosemary plant. Data presented in Table 1 show that foliar application of kinetin at a rate of 40 ppm mostly led to significant increases in the values of all the studied growth parameters in comparison to untreated plants but the increments were less than those due to ascorbic acid or thiamine applications.

Data present in Table 2 emphasized that ascorbic acid significantly increased vegetative growth parameters namely fresh and dry weight of syngonium plant. The highest values were obtained in plants treated with 100 ppm ascorbic acid, these results are in accordance with those obtained by Tarraf *et al.* [2] on lemongrass plants, reported that application of ascorbic acid promoted the growth of plants.

Data presented in Table 2 show that foliar application of the antioxidants, vitamins (thiamine and ascorbic acid) promoted fresh and dry weights of shoots. Foliar application of thiamine 50 ppm significantly increased fresh weight of leaves, stems, roots/plant and fresh weight of the plant by 48.4, 19.5, 37.9 and 32.9% respectively compared to control plants, as well as dry weight,which significantly exceeded by 77.1, 39.5, 55.5 and 53.4%, respectively than that control plants. These results are in line with those obtained by Gamal El-Din [3] on sunflower plant.

Data on the response of fresh weight of leaves, stems and roots as well as fresh weight of the plant to ascorbic acid 100 ppm indicate that there were significant increases in these parameters by 51.5, 27.6. 37.4 and 37.9%, respectively than control plant. The dry weight of the formentioned characters significantly increased by 77.5,

Table 3: Effect of foliar application of thiamine, ascorbic acid and kinetin on chemical constituents of *Syngonium podophyllum* L. plants (means of two seasons 2005 and 2006)

Treatment	Concentrations (ppm)	Chlorophylls as (mg/gm, F. weight) Chl (a)	Chl (b)	Total chl (a+b)	Caroteniods mg/gm F.W	Total carbohydrates (%D.W)	Macronutrients (%D.W) N	P	K
Control	0	0.51	0.18	0.69	0.25	26.33	1.23	0.085	0.32
Thiamine	50	0.76	0.29	1.05	0.30	34.83	1.31	0.099	0.47
	100	0.75	0.23	0.98	0.28	33.77	1.25	0.098	0.44
Ascorbic acid	50	0.62	0.25	0.87	0.31	30.87	1.23	0.096	0.42
	100	0.82	0.34	1.16	0.33	37.00	1.36	0.107	0.49
Kinetin	20	0.59	0.21	0.80	0.27	26.67	1.17	0.093	0.42
	40	0.56	0.20	0.76	0.30	29.13	1.20	0.090	0.42
L.S.D at 5% level		0.02	0.02	0.03	0.2	1.71			

51.3, 55.7 and 61.9%, respectively in response to the application of ascorbic acid at 100 ppm than that of control plant. Similar results were obtained by Abdel Halim [1] on tomato plants. Smirnoff [20] and Tarraf *et al.* [2] mentioned that ascorbite has been implicated in regulation of cell division. In this connection the authors pointed out cell wall ascorbate and cell wall localized ascorbate oxidase has been implicated in content of growth, high ascorbate oxidase activity is associated with rapidly expanding cells. Shaddad *et al.* [21] assumed that the effect of ascorbic acid on plant growth may be due to substantial role of ascorbic acid in many metabolic and physiological processes.

Data in Table 2 show that foliar application of kinetin had insignificant effect on fresh and dry weight of leaves of syngonium plant compared with unthreaded plants, while kinetin application significantly increased fresh and dry weights of roots as well as whole plant. These results are in harmony with those obtained by Hassan and El-Quesni, [12] on carnation plant. The increments of fresh and dry weight of syngonium plant due to kintien application at 20 and 40 ppm may be attributed to the effect of the used treatments on cell division and/or cell elongation.

2- Effect of thiamine, ascorbic acid and kinetin on chemical constituents: Data presented in Table 3 show that foliar application of thiamine, ascorbic acid and kinetin significantly affected the photosynthetic pigments content of syngonium leaves. Data also emphasized that chlorophyll a, chlorophyll b and total caroteniods were significantly increased when plants treated with thiamine, ascorbic acid and kinetin. The highest values of these parameters were obtained in plants treated with ascorbic acid 100 ppm followed by thiamine at 50 ppm in both seasons,respectively.

Total carbohydrate content significantly increased in plants treated with ascorbic acid at 100 ppm, thiamine at 50 ppm and kinetin at 40 ppm, compared with control plants.

Such increments might be attributed to the significant increase in photosynthetic pigments content which reflected on photosynthesis process and led to increase in carbohydrates content. These results are in agreement with those reported by Youssef and Talaat, [4] on rosemary plants and Youssef *et al.* [11] on *Matthiola incana* plants.

Regarding the effect of ascorbic acid foliar application on N, P, K concentrations, the percentages of N, P and K were gradually increased by increasing the concentration of ascorbic acid to 100 ppm compared with the untreated plants. The increment in N concentration due to ascorbic acid and thiamine treatments could be explained by the findings of Talaat [7] who showed that the accumulation of nitrate by ascorbic acid foliar application may be due to the positive effect of ascorbic acid on root growth which consequeantly increased nitrate absorption. In this context the increase in P concentration by thiamine and ascorbic acid treatments may be attributed to the postulation of Hanafy *et al.* [22] who mentioned that foliar spray with ascorbic acid might be increase the organic acids exerted from the roots into the soil and consequently increase the solubility of most nutrients which release slowly into the rhizosphere zone where it may be utilized by plants.

From the above mentioned results, it could be concluded that the antioxidant (vitamins); ascorbic acid and thiamine, might be play a role in many metabolic and physiological processes, through affecting the metabolism of photosynthesis process which led to increase in carbohydrates content and vegetative growth as indication for foliage quality.

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