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Chemical constituents of *Celosia argentea* va. cristata L. plants as affected by foliar application of putrescine and alpha-tocopherol

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Abstract: The effect of putrescine at 50,100 and 200 ppm and alpha- tocopherol at 200, 400 and 600 ppm on chemical constituents of *Celosia argentea* var. cristata L. plants had been studied in pot experiment during two successive seasons (2009-2010) and (2010-2011). Data indicated that most criteria of chlorophylls, anthocyanin and total carbohydrates contents were significantly affected by the application of putrescine and alpha- tocopherol as compared with the control plants. Foliar application with 200 ppm putrescine resulted in the highest increase values in these studied characters as compared with the other treatments and the untreated plants in the two seasons of study. Spraying the plants with alpha- tocopherol at the concentration of 400 ppm resulted in the highest values as compared to the control plants in the two successive seasons.
Keywords: *Celosia cristata*, putrescine, alpha-tocopherol, chlorophylls, anthocyanin , total carbohydrate.

Introduction

Celosia argentea var. cristata is an herbaceous plant, family Amaranthaceae. *Celosia* is one of the most popular of the field cut flowers. The plant is used frequently as an indoors ornamental plant, its leaves and flowers can be used as vegetables, which can be used as foods in India, Western Africa, and South America. It has distinctive characteristic inflorescence, which looks like the crest of a rooster or convoluted brain after its full development[1]. Owing to the dazzling and attractive inflorescences are usually brightly colored in red, yellow, pink, or orange though other colors can be present. It is a popular ornamental plant, which has some medical purposes by producing some useful chemicals such as antiviral proteins, betalains and anthocyanin[2].

Polyamines are beneficial subgroups of amines, divided into aliphatic di- amine putrescine, tri- amine spermidine, and tetra amine spermine. The main polyamine in vegetables and fruits is either putrescine or spermidine. Moreover, there is a strong association between polyamine metabolism in plants and environmental stress, e.g. nutrient deficiency, drought, soil salinity, or temperature stress[3]. [4]concluded that foliar application of putrescine at the concentration of 150 ppm on *Salvia splendens* plants significantly increased chlorophyll a, b, carotenoids, anthocyanin and carbohydrate contents as compared with the untreated plants.

Alpha-tocopherol (Vitamin E) is a low molecular weight lipophilic antioxidant, which mainly protect membranes from oxidative damage [5]. Tocopherols were proposed to function in relation to their antioxidant properties being prominent in protection of poly unsaturated fatty acids from lipid peroxidation by quenching and scavenging various reactive oxygen radicals. Also, in plants tocopherol levels vary in different tissues and fluctuate during its development and in response to abiotic stresses[6]. [7] found that treated Calendula plant with 50ppm alpha-tocopherol increased Chl. a, b content and reducing sugars as compared with the untreated plants.

The aim of this study was to investigate the effects of Putrescine and Alpha-tocopherol on chemical constituents of *Celosia argentea* var. cristata L.plant.

Materials and Methods

A pot experiment was carried out during the seasons (2009-2010) and (2010-2011) in the greenhouse of the National Research Centre, Dokki, Giza, Egypt to investigate the influence of putrescine (Put.) and alpha-tocopherol (V.E) application on chemical constituents of *Celosia argentea* var. cristata L. plant.

Uniformed *Celosia* seedlings were (7 cm) in length, bearing (4 pairs) of leaves. Each seedling was transplanted on 15th of June for both seasons in 30cm diameter clay pot, filled with 8 kg growing media consisted of loamy clay and sand at the ratio of 1:1 (v/v). After two weeks from transplanting all seedlings received equal dose (4gm/pot) of N.P.K fertilizer (19:19:19) from ammonium nitrate, tri phosphates and potassium sulphate, respectively and regularly irrigated with tap water. On 15th July in both seasons, the plants were sprayed till run off point either with the growth regulator putrescine: (Put.) at the concentrations of 0, 50, 100 and 200ppm or alpha-tocopherol (V.E) at the concentrations of 0, 200, 400 and 600ppm, while the control plants were sprayed with tap water. The second spray had been carried out after two weeks from the 1st one. Thus, seven treatments were carried out, in three replicates, each replicate consisted of three plants. The layout of the experiment was completely randomized design. The following data were recorded: plant height (cm), No. of leaves; fresh and dry weight of leaves (g), stem diameter (cm), fresh and dry weight of stem (g), inflorescence length (cm) and inflorescence diameter (cm), fresh and dry weight of inflorescence (g). The data were subjected to statistical analysis of variance according to [8].

Results and Discussion

1. Effect of putrescine and alpha-tocopherol on Chlorophyll (a, b) and total carotenoids content (mg/g. F.W.)

The data in Fig. (1, 2 and 3) illustrated that, spraying *Celosia* plants with putrescine at the concentrations of 50, 100 and 200ppm significantly increased the chlorophyll (a, b) and total carotenoids content in the leaves. Spraying putrescine at 200ppm resulted in the highest values as compared with the other treatments. These results are in line with those obtained by [9]on *Matthiola incana*, [10]on *Catharanthus roseus* L., [11] on gladiolus plant, [12]on *Chrysanthemum indicum* plant, [13]*Syngonium podophyllum* plant, [14]on *Dahlia pinnata* plant and [4]on *Salvia splendens*. They reported that, putrescine treatments increased chlorophyll (a, b) and total carotenoids content.

It was reported that polyamines have been found to affect protein synthesis and nitrogen compound metabolism[15,16]. Moreover, putrescine induced effects on chlorophylls content; polyamines stimulated some physiological responses including vegetative growth and photosynthetic activity[17,18].

concerning the effect of alpha-tocopherol on the content of chl. (a) in *Celosia* plants, the data indicated that all the used concentrations significantly increased chlorophyll (a, b) and total carotenoides content in the leaves as compared with the control plants. The highest value for plants treated with 400ppm alpha-tocopherol.

These results are in agreement with those obtained by[19] on Faba bean plants, [20]on Snap bean plants, [21]on wheat plants, [22]on cowpea plants and [23]on Hibiscus plants. They concluded that increases in chlorophyll a, b and carotenoids might be due to the role of antioxidant in protecting chloroplast from oxidative damage[24].

In the plants, it was explained that tocopherols are presumed to act as membrane – associated antioxidants and structural components of membranes, although all the evidence supporting this role is limited[25].

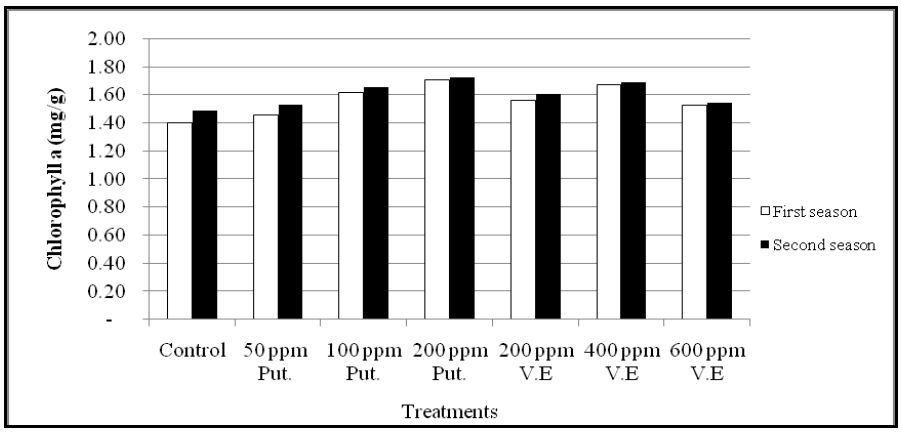

Fig.1. Chlorophyll a content (mg/g. F.W.) in leaves of *Celosia argentea* var. Cristata plant as affected by putrescine (put.) and alpha-tocopherol (V.E) treatments during 2009/2010 and 2010/2011 seasons.

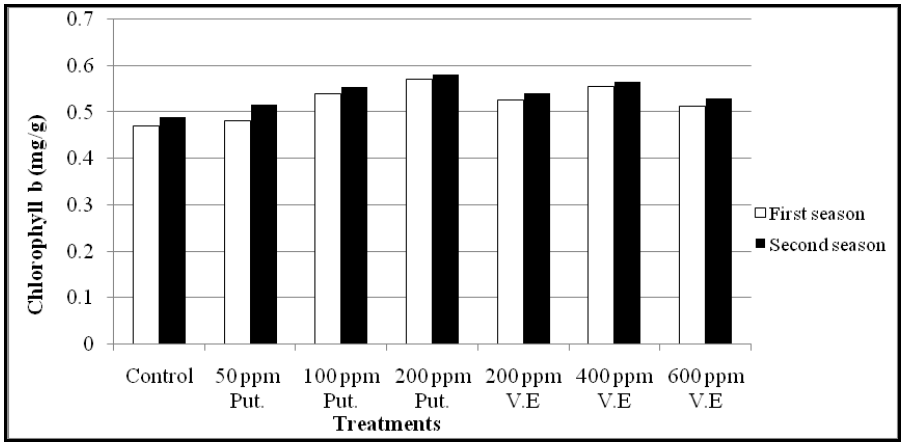

Fig.2. Chlorophyll b content (mg/g. F.W.) in leaves of *Celosia argentea* var. Cristata plant as affected by putrescine (put.) and alpha-tocopherol (V.E) treatments during 2009/2010 and 2010/2011 seasons.

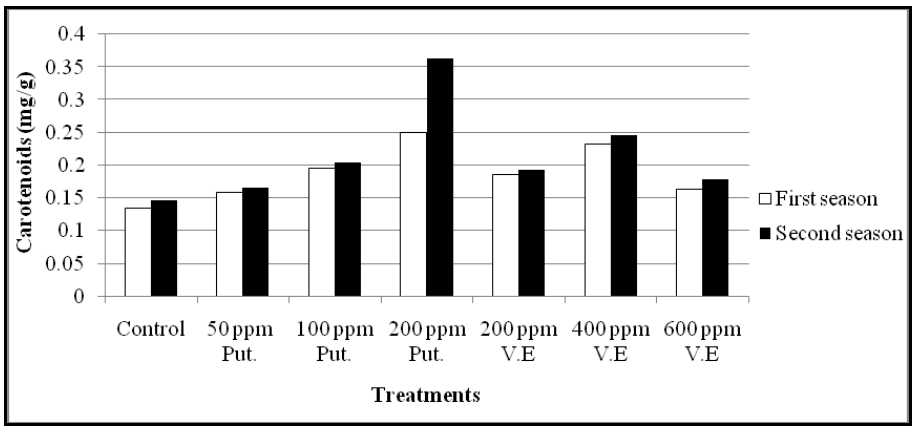

Fig.3. Carotenoids content (mg/g. F.W.) in the leaves of *Celosia argentea* var. Cristata plant as affected by putrescine (put.) and alpha-tocopherol (V.E) treatments during 2009/2010 and 2010/2011 seasons.

2. Anthocyanin content (g/100g. F.W.)

The data presented in Table (1) revealed that, foliar application of *Celosia* plants with putrescine and alpha-tocopherol at different concentrations resulted in the highest significant increase of anthocyanin content in the inflorescences in both seasons, as compared with the control plants.

Regarding the effect of putrescine treatments, the data showed high anthocyanin content at the different concentrations. The highest anthocyanin value (12.55 and 13.75 g/100g F.W.) of inflorescences were determined in the plants treated with 200 ppm putrescine. The increments were (150.4 and 126.8%) as compared with the untreated plants (5.01 and 6.06) for the 1st and 2nd season, respectively. Raising the concentration of putrescine increased anthocyanin content, whereas within alpha-tocopherol concentrations, a reduction of anthocyanin had been obtained by raising its concentrations; however, the lowest values are higher than the control plants. These results are in agreement with those obtained by [26] on *Arabidopsis thaliana*, [27]on *Curcuma alismatifolia* and [28]on *Lilium longiflora* and [4]on *Salvia splendens*. In this concern, [29] reported that, gibberellic acid can infuse some genes of essential enzymes in anthocyanin production pathway such as chalkon synthetase, chalkon isomerase, di-hydro flavenol reductase. [30]reported that, gibberellic acid regulates phenyl alanin amoniliyase activity, which increase anthocyanin content in plant culture.

In case of alpha-tocopherol treatments, it is clear that, foliar application of *Celosia* plants of 200, 400 and 600ppm resulted in significant increase by (10.88, 11.3 and 9.4 g/100g F.W.) in inflorescences in the 1st season. The highest content was determined when the plants were sprayed with 400 ppm alpha-tocopherol. The increments were 125.5% and 102.1%, as compared with the control plants (5.01 and 6.06) for the two successive seasons, respectively.

In this respect, it was found that the anthocyanin fraction was the most effective both in scavenging reactive oxygen species and in inhibiting lipoprotein oxidation and platelet aggregation[31]. The high antioxidant capacity of blueberries has been highly correlated to their anthocyanin and total phenolic content . Antioxidant activity correlates well with total phenolics content and anthocyanin content in blueberry [32]. Also, [33] concluded that anthocyanins and 3-deoxyanthocyanidin however have roles in the flowering plants other than as attractants, acting as antioxidants, phytoalexins or as antibacterial agents.

Table (1). Anthocyanin content (g/100g. F.W.) in *Celosia argentea* var. Cristata inflorescences as affected by putrescine (put.) and alpha-tocopherol (V.E) treatments during 2009/2010 and 2010/2011 seasons

Treatments	2009/2010	2010/2011
	Anthocyanin content (g/100g. F.W.)	
Control	5.01	6.06
50 ppm Put.	6.35	6.66
100 ppm Put.	7.23	8.55
200 ppm Put.	12.55	13.75
200 ppm V.E	10.88	11.40
400 ppm V.E	11.30	12.25
600 ppm V.E	9.40	10.37
$LSD_{0.05}$:	0.39	0.56

Putrescine: put. , Alpha-tocopherol: V.E

3. Total carbohydrates contents

Total carbohydrates (in shoots and inflorescences)

The data presented in Table (2) indicated significant effect on increasing total carbohydrates content in shoots and inflorescences of *Celosia* plants as affected by putrescine and alpha-tocopherol treatments.

Using putrescine at the concentrations of 50, 100 and 200ppm significantly increased total carbohydrates content in the shoots giving (22.5, 24.22 and 28.33%), respectively, as compared with the control plants (19%) in the 1st season. Similar trend was found in the 2nd season.

In case of the inflorescence, using putrescine (50, 100 and 200ppm) resulted in high significant increase in the total carbohydrates content giving (25.33, 27.6 and 35.31%), respectively, as compared with the untreated plants (22%) in the 1st season. In the 2nd season similar trend was obtained. These increments in total carbohydrates content may be due to the increase in photosynthetic process efficiency, which led to the increase assimilation of leaf CO_2.

These results are in agreement with those obtained by [34] on *Dianthus caryophyllus*, [12]on *Chrysanthemum indicum* and [4]on *Salvia splendens*. They reported that, using putrescine at different concentrations increased the total carbohydrates content in the plants.

Concerning the effect of alpha-tocopherol on carbohydrates content in the shoots, it was found that, spraying the plants with the three used concentrations significantly increased total carbohydrates content. The highest value of carbohydrates (27.0 and 30.39%) was determined in the plants were treated with 400ppm alpha-tocopherol in the 1st and 2nd season, respectively. The increments were (42.11 and 51.95%) as compared with the untreated plants.

In case of the inflorescences, it was clear that, spraying the plants with alpha-tocopherol at the concentrations of 200, 400 and 600ppm significantly increased total carbohydrates content as compared with the untreated plants. The highest content (32.39 and 37.5%) was determined when the plants were sprayed with 400ppm alpha-tocopherol giving in the 1st and 2nd season, respectively.

Our results are in accordance with [19] on Faba bean plants, [20] on snap bean plants[21]on Wheat plant [23] on Hibiscus plants and [35] on Jasminum plants. They reported that the absence of tocopherols dramatically impacts primary carbohydrates metabolism in the plant, moreover, tocopherol accumulates elevated levels of sugars. [36] claimed that tocopherol plays crucial role on maintaining the photos simulated substances, which are exported from leaves as a main source**.**

Table 2. Total carbohydrates (% D.W) in shoots and inflorescences of *Celosia argentea* var. Cristata plants as affected by putrescine and alpha-tocopherol (V.E) treatments during (2009/2010) and (2010/2011)

Treatments	Total carbohydrates			
	(% D.W) in the shoots		(% D.W) in the inflorescences	
	2009/2010	2010/2011	2009/2010	2010/2011
Control	19.00	20.00	22.00	23.92
50 ppm Put.	22.50	23.25	25.33	28.50
100 ppm Put.	24.22	24.50	27.60	31.35
200 ppm Put.	28.33	31.31	35.31	40.25
200 ppm V.E	25.16	28.43	30.13	35.05
400 ppm V.E	27.00	30.39	32.39	37.50
600 ppm V.E	24.80	26.30	28.89	33.75
LSD $_{0.05}$:	1.37	2.43	1.87	2.55

Putrescine: put. , Alpha-tocopherol: V.E

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