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Response of *Dahlia pinnata* L. Plant to Foliar Spray with Putrescine and Thiamine on Growth, Flowering and Photosynthetic Pigments

Mona H. Mahgoub, Nahed G. Abd El Aziz and Azza M.A. Mazhar

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

Abstract: Pot experiments were carried out during two successive seasons of 2008/2009 and 2009/2010 in the greenhouse of National Research Centre, Dokki, Giza, Egypt to study the effect of foliar application of putrescine (50,100 and 150 ppm) and thiamine (50,100 and 150 ppm) in addition to untreated plants as control on vegetative growth, flowering and photosynthetic pigments of *Dahlia pinnata* L. Spraying plants with putrescine and thiamine significantly increased plant height, number of branches, number of leaves, fresh and dry weight of leaves, stem diameter and fresh and dry weight of stem. The highest values were obtained when plants treated with 150 ppm putrescine followed by 100 ppm thiamine than that the other treatments or with untreated plants. Foliar application of putrescine and thiamine increased yield of flower, flower characters and chlorophyll contents than untreated one. The best results were found at 150 ppm putrescine followed by 100 ppm thiamine than control plants.

Key words: Cut flowers · Polyamines · Vitamins

INTRODUCTION

Dahlia is an important bulb crop world wide as garden or poll. *Dahlias* is mainly produced using vegetative propagation. *Dahlia* is a genus of bushy, tuberous, perennial plants native to Maxico, Central America and Colombia. It is belong to Asteraceae or Composita or daisy, or aster family, there are at least 36 species of dahlia, the first species that were the starting point in getting varieties, more and more interesting by setting up to flowers and their color [1]. Dahlia plants ranged from as low as in (30 cm) to as tall as (1.8-2.4m). The flowers can be as small as (5.1 cm) in diameter or up to (30 cm). The great variety results from dahlia being octoploids (they have eight sets of homologous chromosomes) where the most plants have only two. There were several thousand varieties of dahlia with simple or abundant flowers, but of which very few have been preserved to this day [2].

Polyamines (PAS): purescine (Put), spermine (spm) and spermidine (spd) are recognized as a new class of plant growth bio-regulators causing increases in shoot growth which might be due to the enhancement of cell division activity [3], they also enhanced biosynthesis enzymes, modulated several growth development processes, cell division, differentiation, flowering, fruit ripening and senescence [4]. Polyamine may inhibit senescence-increasing of protease activity and loss of chlorophyll and synthesis of ethylene [5]. Polyamines are important factors regulating sugar and carbohydrate biosynthesis. They act as plant growth regulators and may be involved in many biological systems and have been show to be closely associated with carbohydrate biosynthesis [6]. Vitamin could be considered as bio-regulators compound which influence upon plant growth by using a little concentration. Thiamine (Vitamin B_1) was first isolated as the "anti-beriberi factor" from rice polishing in 1926. Its biochemical action in treating beriberi, a lethal diseases which is common in developing countries where the main food source is low in thiamine and high in carbohydrate [7]. Thiamine is composed of a pyrimidine (4-amino-2-methle-5-pyrimidine) ring linked to thiazole (4-methyl-5-β hydroxyethylthiazolium) ring by a methylene bridge. It can be phosphorylated on its hydroxyl group to form monophosphate (TMP), (TDP) and (TTP) esters. Thiamin diphosphate plays a fundamental role as an enzymatic cofactor in universal metabolic pathways including glycolysis and the tricarboxylic acid cylic and exerts functions other than as a cofactor in response to biotic and abiotic stress [8-11]. In these respect Yossef and Talaat [12] and

Corresponding Author: Mona H. Mahgoub, Department of Ornamental Plants and Woody Trees, National Research Centre, Dokki, Giza, Egypt.

Abdel-Aziz *et al.* [13] reported that application of thiamine at different concentrations in rosemary and gladiolus plants increased vegetative growth, flowering and chemical composition.

MATERIALS AND METHODS

This study was carried out in the greenhouse of National Research Centre, Dokki, Giza, Egypt during two successive season of 2008/2009 and 2009/2010 to investigate the effect of foliar application of putrescine and thiamine (Vitamin B_1) on vegetative growth, flowering and photosynthetic pigments (Chl. a,b and carotenoids) on *Dahlia pinnata* plants. Seedlings were obtained from ornamental plant Research, Ministry of Agricultural, Egypt, the seedling were transplanted on 15th October during 2008/2009 and 2009/2010 seasons, in pots 30cm in diameter filled with 10 kg of pet-lomy and sand soil (1:1v/v), arranged in a complete randomized design with three replicates. Each replicate consists of three plants. Each pot was fertilized twice with 1.5g nitrogen as ammonium nitrate (33.5% N) and 1g potassium sulfate (48-50% K_2O). The fertilizers were applied at 30 and 60 days after transplanting. Phosphorus as calcium super phosphate (15.5% P_2O_2) was mixed with media before transplanting at the rate of 3 g/pot. Plant were sprayed with different concentrations of putrescine (50,100 and 150 ppm), thiamine (50,100 and 150 ppm) and untreated plants, which sprayed with tap water. Foliar application of putrescine and thiamine were carried out twice (30 and 60 days from transplanting) as foliar sprays to cover completely the plant foliage until drip.

At the beginning of March 2009 and 2010, flowers were collected biweekly and the following flower characters: number of flowers, flower diameter (cm), stalk length (cm) and fresh and dry weights of flowers(g) were recorded till 15th May 2009 and 2010. The following characters were also determined: plant height (cm), number of leaves/plant, number of branches /plant, fresh and dry weights of leaves (g), stem diameter (cm), fresh and dry weights of stem (g), number of flowers, flower diameter (cm), stalk length (cm), fresh and dry weights of flowers (g). The yield of flowers was recorded by collecting the number of flowers, fresh and dry weights of flowers (g) at all times. Chlorophyll a, b and carotenoids content were determined in fresh leaves as mg/g fresh weight according to the procedure achieved by Saric *et al* [14].

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 Snedcor and Cochran [15].

RESULTS AND DISCUSSION

Vegetative Growth: Data presented in Table 1 showed that foliar application of 50,100 and 150 ppm putrescine and thiamine (Vitamin B_1), significantly promoted vegetative growth of dahlia plants compared with control plants. Application of putrescine to dahlia plants significantly promoted plant height, number of branches, number of leaves, fresh and dry weight of leaves, stem diameter and fresh and dry weight of stem. Increasing putrescine concentration up to 150 ppm significantly increased growth criteria, the increments were 93.1, 125.1, 132.5, 159.1, 185.4, 48.6, 118.9 and 136.9%, respectively compared with untreated plants. In this connection, Youssef *et al.* [16] on *Matthiola incanna* plants reported that application of putrescine significantly promoted plant height, number of leaves/plant, fresh and dry weight of leaves/plant especially at 250 mg/L. Similar results were found also by Talaat *et al.* [17] on periwinkle plant, Mahgoub *et al.* [18] on *Dianthus caryophyllus* plants, Abdel-Aziz *et al.* [13] on gladiolus plants and El-Sayed [19] on chrysanthemum plants. These results may be due

Table 1: Effect of Putrescine and Thiamine on vegetative growth of *Dahlia pinnata* L. plants during 2008/2009 and 2009/2010 (means of two seasons)

Treatments	Plant height (cm)	Number of branches/plant	Number of leaves/plant	Leaves fresh weight (g)	Leaves dry weight (g)	Stem diameter (cm)	Stem fresh weight (g)	Stem dry weight (g)
Control	34.00	5.33	53.33	18.97	4.65	0.70	31.54	8.74
Put.50 ppm	42.00	7.25	76.33	23.47	5.94	0.89	47.39	13.51
Put.100 ppm	52.33	9.30	92.67	33.50	8.78	0.95	53.2	15.59
Put.150 ppm	65.67	12.00	124.00	49.16	13.27	1.04	69.04	20.71
Thia.50 ppm	48.25	8.50	88.50	27.08	6.99	0.93	50.47	14.54
Thia.100 ppm	57.33	10.43	119.00	38.83	10.33	0.97	60.22	17.95
Thia.150 ppm	40.00	6.00	65.00	21.58	5.40	0.84	40.71	11.44
LSD 0.05	3.41	0.67	7.16	3.65	1.04	0.04	5.53	2 .00

Put = Putrescine, Thia = Thiamine

to polyamine having been implicated in a wide range of biological processes including growth development and abiotic stress responses and cell division, differentiation. Kuechnbuch and Pillips [20], also Galston [3] noticed that polyamines are currently considered to be regulators of plant growth and development. Owing to their effect on cell division and differentiation.

With regard the effect of thiamine treatments on dahlia plants, data in Table 1 emphasized that foliar application of thiamine on dahlia plants significantly promoted plant growth, while application of 100 ppm thiamine led to the highest values of growth parameters, the increments were 68.6, 95.7, 123.1, 104.7, 122.2, 38.6, 90.9% and 105.4% respectively than untreated plants. These results are agreement with Youssef and Talaat [12] on rosemary, El-Fawakhry and El-Tayeb [21] on chrysanthemum, Youssef *et al.* [16] on matthiola plants, Gamal El-Din [22] on sunflower and Abdel-Aziz *et al.* [13] on gladiolus.Thiamine is necessary ingredient for the biosynthesis of coenzyme thiamine pyrophosphate, in this latter form it plays an important role in carbohydrate metabolism. It is an essential nutrient for plant, it is synthesized in the leaves and is transported to the roots where it controls growth [23].

Flowering: Data presented in Figs.1-5 illustrated that foliar application of putrescine and thiamine treatments on dahlia plants significantly increased number of flowers, flower diameter (cm), stalk length (cm) and fresh and dry weight of flowers (g/plant) compared with control treatment after 120,135,150,165 and 180 days from transplanting. Foliar application of putrescine at 150 ppm gave the highest significant increase in flowering growth, the increments were 91.76, 88.8, 181.3, 116.4 and 170.2% compared with untreated plants. The maximum flowers number was obtained after 150 days from collection, while the lowest was obtained after 120 days from transplanting. Similar trend was found in other characters. In support of these results significant influence of putrescine in increasing number of flower, flower diameter, stalk length, fresh and dry weight of flowers has been experimentally substantiated by El-Sayed [19] on chrysanthemum, Mahgoub *et al.* [18] on *Dianthus caryophyllus* and Abdel-Aziz *et al.* [13] on gladiolus plant. They reported that putrescine was more effective on fresh and dry weight of plants. This may be explained that putrescine enhanced the accumulation of the produced in the plant tissues, i.e. flowers. The conjugated polyamines are known to be associated with the physiology of flowering [24].

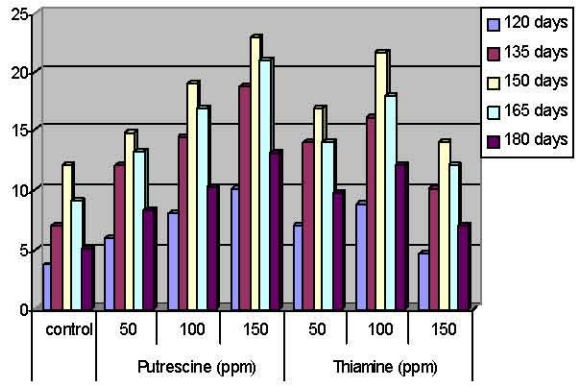

Fig. 1: Effect of putrescine and thiamine treatments on number of flowers of *Dahlia pinnata* plants during (2008/2009 and 2009/2010) means of two seasons.

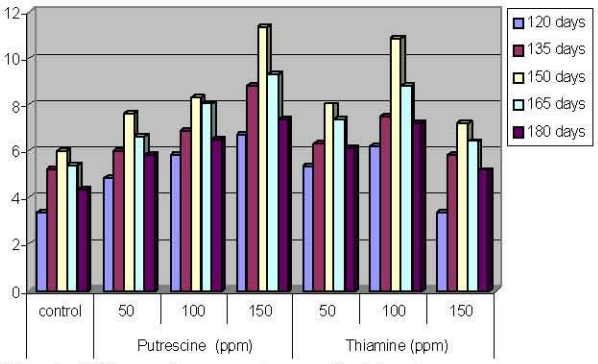

Fig. 2: Effect of putrescine and thiamine treatments on flower diameter of *Dahlia pinnata* plants during (2008/2009and 2009/2010) means of two seasons.

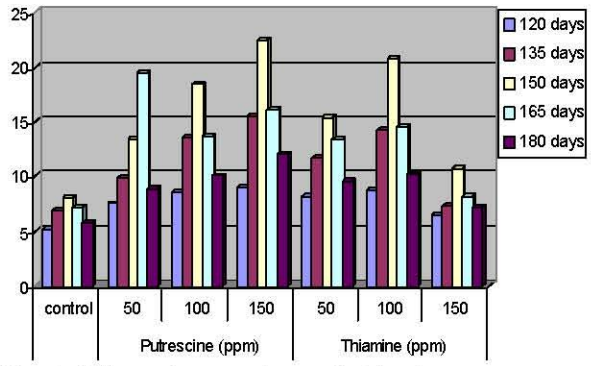

Fig. 3: Effect of putrescine and thiamine treatments on stalk flower length of *Dahlia pinnata* plant during (2008/2009and 2009/2010) means of two seasons.

Regarding the effect of thiamine treatments, data presented in Figs. 1-5. Illustrated that using thiamine at the rate of 100 ppm had the highest values of all flower characters compared with the other treatments of thiamine and untreated plants. The maximum flowers number, stem diameter, stalk length and fresh and dray weight of

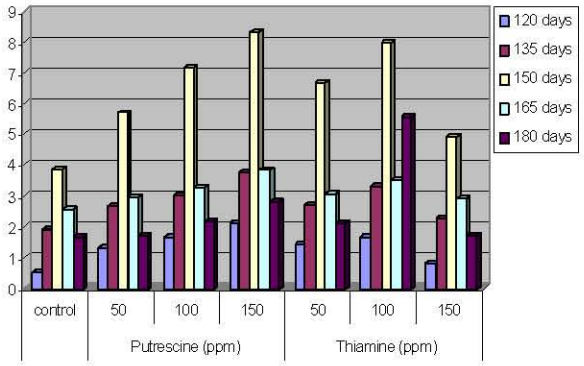

Fig. 4: Effect of putrescine and thiamine treatments on flower fresh weight of Dahlia pinnata plants during (2008/2009and 2009/2010) means of two seasons.

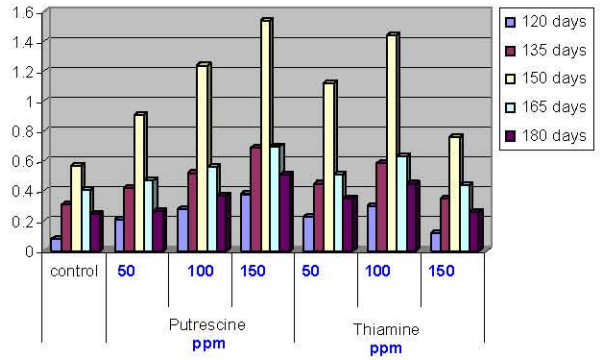

Fig. 5: Effect of putrescine and thiamine treatments on flower dry weight of Dahlia pinnata plants during (2008/2009and 2009/2010) means of two seasons.

flowers resulted after 150 days from transplanting (80.6, 81.2, 160.4, 107.8 and 152.6%). Our results are in agreement with those obtained by Abdel-Aziz *et al.* [13] on gladiolus plants. Vitamins could be considered as a bio-regulators compound which in little concentrations exerted a profound influence upon plant growth. In general, the energy metabolic pathway could be affected by one or another of these substances [25].

Flowers Yield: Data presented in Table 2 revealed that application of putrescine at all used concentrations increased number of flowers/plant, fresh and dry weight of flowers. The highest values of these traits (133.98, 95.22 and 122.99 %, respectively) were recorded with applying 150 ppm putrescine compared with untreated plants. These results are in accordance with the findings of Mahgoub *et al.* [18] on *Dianthus caryophyllus* plants reported that application of 200 ppm putrescine significantly increased number of flowers/plant, fresh and dry weight of flowers, Youssef *et al.* [26] on *Datura innoxia* stated that application of 100 ppm phenylalanine + 100 ppm putrescine significantly increased parameters in all flowering stages, Abdel-Aziz *et al.* [13] on gladiolus, stated that application of 200 ppm putrescine had a promotive effect on cormlets and florets characters of gladiolus plants and El-Sayed [19] on chrysanthemum plants reported that using 200 ppm putrescine increased the flower yield, longest vase life of flowering, yield of flower and fresh and dry weight of flowers. These results may be due to the promotive effect of putrescine, which is essential for plant growth and differentiation and thus involved in various physiological processes [27, 28]. Regarding the effect of thiamine on Dahlia flowering it was found that all used concentrations significantly increased number of flowers/plant and fresh and dry weight of flowers, the best results were found when plants treated with 100 ppm thiamine which recorded 108.2, 78.3 and 100.5%, respectively compared with untreated plants followed by 50 ppm and/or 150 ppm thiamine. Similar results were obtained by El-Fawakhry and El-Tayeb [21] on chrysanthemum and Abdel-Aziz *et al.* [13] on gladiolus, they concluded that thiamine treatments increased flower parameters. Thiamine is an important cofactor for the transketolation reactions of the pentose phosphate cycle, which provides pentose phosphate for nucleotide synthesis and for the reduced NADP required for various synthetic pathways [23].

Table 2: Effect of Putrescine and Thiamine on yield of flowers of *Dahlia pinnata* L. plants during (2008/2009 and 2009/2010).means of two seasons

	Yield of flowers		
Treatments	Number of flowers/plant	Fresh weight of flowers (g/plant)	Dry weight of flowers (g/plant)
Control	36.67	10.67	1.87
Put.50ppm	54.17	14.36	2.64
Put.100ppm	68.47	17.28	3.34
Put.150ppm	85.80	20.83	4.17
Thia.50ppm	61.67	15.99	2.99
Thia.100ppm	76.34	19.02	3.75
Thia.150ppm	59.35	12.62	2.29

Put=Putrescine, Thia=Thiamine

Table 3: Effect of Putrescine and Thiamine treatments on photosynthetic pigments of *Dahlia pinnata* L. plants during (2008/2009 and 2009/2010) means of two seasons

	Photosynthetic pigment(mg/g. fresh weight)			
Treatments	Chl. a	Chl. b	Chl. a+b	Carotenoids
Control	1.08	0.28	1.36	0.08
Put. 50 ppm	1.11	0.34	1.45	0.13
Put. 100 ppm	1.15	0.38	1.53	0.17
Put. 150 ppm	1.20	0.42	1.62	0.23
Thia. 50 ppm	1.14	0.35	1.49	0.16
Thia. 100 ppm	1.18	0.4	1.59	0.21
Thia. 150 ppm	1.13	0.31	1.44	0.11
LSD 0.05	0.02	0.01	0.03	0.01

Put=Putrescine, Thia=Thiamine

Photosynthetic Pigments: Data presented in Table 3 showed that chlorophyll (a) significantly increased by increasing putrescine from 50 to 100 and/ or 150 ppm. The increments estimated by 2.78, 6.48 and 11.11%, respectively compared with untreated plants. Whereas the increments of chlorophyll (b) estimated by 21.4, 35.7 and 50.0%, respectively compared with untreated plants. The same results were noticed in chlorophyll a+b and carotenoids contents. From the obvious results it was found that the best results were found when plants treated with 150 ppm putrescine.These results are in line with those obtained by Talaat *et al.* [17] on *Catharanthus roseus*, Abdel-Aziz *et al.* [13] on gladiolus plant and El-Sayed [19] on chrysanthemum plants, they reported that putrescine treatments increased Chl. (a), (b) and total Carotenoids content. Polyamine has been found to affect-protein-synthesis and nitrogen compound metabolism [29] and [30]. Moreover, putrescine include effects on chlorophylls content, polyamines stimulated some physiological responses including vegetative growth and photosynthetic activity [31, 32]. Exogenous application of putrescine to several plant species have been shown to retarded chlorophyll loss and senescence [33].

In case of thiamine treatments on Dahlia plant it was found that significantly increased photosynthetic pigments content the highest values of Chl. a,b,(a+b) and total carotenoids were obtained when plants treated with 100 ppm thiamine which recorded 9.3, 42.9, 16.9 and 162.6% respectively compared with untreated plants. These results are in agreement with the findings reported by Abdel-Aziz *et al.* [34] on syngonium, they reported that the highest values of Chl.(a),(b) and total carotenoids were obtained when plants treated with 50 ppm thiamine. In addition, Abdel-Aziz *et al.* [13] found that application of 100 ppm thiamine gave the best results on chlorophylls content than the other treatments and control plants of gladiolus.

Thus, it could be recommended that foliar application with 150 ppm putrescine and thiamine at 100 ppm increased growth, flowering and photosynthetic pigments in dahlia plants.

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