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Response of Matthiola incana to spraying with boric acid and Vitamin E

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Abstract

An experiment was carried out to exam the foliar feeding of boric acid at the concentration 0, 20 and 40 mg.l^{-1} and three levels of vitamin E 0, 40 and 80 mg.l^{-1}. on growth and flowering parameters. The results showed that spraying boric acid at a concentration of 40 mg.l^{-1} with vitamin E at a concentration of 40 mg.l^{-1} led to a significant increase in the total number of leaves and branches, leaf content of total chlorophyll and total dissolved carbohydrates in leaves, number of inflorescences and florets, florets diameter, inflorescences stem length, flowering duration and Anthocyanin pigment.

Key words: Stock plant (*Matthiola incana* L.), RCBD, Boric acid, Vitamin E, spraying

Introduction

Stock plant is one of the most important ornamental plants in Iraq and the world. It is a plant of Crucifera family. It is grown in home gardens and public parks because of its colorful flowers, its strong aromatic scent, and it is suitable as a cutflowers. Its original habitat is the regions of the Mediterranean basin and the Canary Islands. It is preferred to grow it in fertile soils rich in nutrients (El-Batal 2005). Its inflorescences are clustered with florets lined up on the stem of many colors, including white, pink, yellow, red and purple. These colors are due to the presence of many plant pigments in this plant, including the anthocyanin pigment.

The primary aims of foliar fertilization is to allow for quick absorption and utilization of the nutrients and to treat the symptoms visible on the leaves due to a specific deficiency in one or more nutrients, and to notice the increase in growth and yield of plant. In addition to the fact that this method is economical by reducing the need for large quantities of nutrients, compared to other methods (Joly 1993), including Boron (B) for its importance in the physiological processes and biological reactions in plants. Since it was found that B is necessary for protein synthesis and increased vitamin C and sugars and has an effect on hormonal processes such as Auxin (IAA) and the production of growth regulators such as gibberellin. It also plays an important role in the development and growth of developing top meristem, as it is included in the processes of cell division, Al-Fatlawi (2007) found that when spraying *Dahlia variabilis* with B, an increase in plant height, number of leaves and stem diameter compared to the comparison treatment, which gave the lowest rate. Al-Mahdawi (2008) also showed that when spraying *Dianthus caryophyllus* L., with B at a concentration of 20 mg. l^{-1}, there was a significant increase in flower stem length, flower diameter and leaf content of total chlorophyll.

Vitamins are bio-regulators compounds found in trace amounts in plant tissue and play an important role in the metabolism of living cells. Adding vitamins to the plant stimulates growth by activating some enzymatic reactions (Kefeli 1981). The Exogenous application of vitamins leads to an increase in production by stimulating the formation of roots and flowers. Vitamins are treated either by soaking the seeds, by spraying or by soil injection (Oertli 1987). Vitamin E (alpha-tocopherol) is a soluble prime lipid found in PUFA-rich membranes (Shao *et al*. 2008). It is found in all parts of the plant, but chloroplast membranes are one of the parts of plants that contain it the most. Abbasi (2007) demonstrated the protection mechanisms of vitamin E through the main protection of the membranes, which is through the removal of the roots of polyunsaturated fatty acids, the capture of the types of active oxygen that arise through metabolic processes, and the protection of the photosynthetic system from high luminosity that causes oxidative damage to the membranes. Chloroplasts through the oxidation of lipids. Sadiq (2014) found when studying the effect of spraying Angelina variety rose hybrid with vitamin E with concentrations 0, 50, 100, 200 mg.l^{-1} significant increase in plant height, number of leaves, dry weight of the shoot, number of flowers, vice life and flowers diameter. The results of El-Saady *et al* (2015) showed that when treating *Antirrhinum Majus* L. with a concentration of 800 mg. l^{-1} of vitamin E, there was a significant increase in plant height, number of leaves, dry weight of the Shoot and Root system, length of inflorescences and number of flowering inflorescences.

Due to the importance of B in the plant and the role of vitamins, including vitamin E, in improving the growth and flowering characteristics of hoary stock, as one of the important ornamental plants, therefore the objective of this study was to assess the effect of spraying B and vitamin E on growth and flowering indicators and improving the quality of its harvested flowers.

Materials and Methods

The study was carried out in the nursery of the Faculty of Agriculture, University of Kufa during the 2018/2019 agricultural season in a house covered with green saran to demonstrate the response of stock plant to spraying with boric acid and vitamin E on characteristics of growth and flowering. The seeds were planted on September 20, 2018, produced by Euro Garden, a Spanish variety in offsets. After the emergence of four real leaves on the seedlings, they were spread into pots with a diameter of 15 cm and a height of 20 cm containing an agricultural medium consisting of soil and peat moss in a ratio of 1:3. All service operations, including irrigation and weeding, were performed for all transactions. Random samples were taken from potted soils for the purpose of analyzing their physical and chemical properties in the postgraduate laboratories of the Faculty of Agriculture, University of Kufa. Table (1) shows the analysis of potted soil.

Table 1. Shows the analysis of potted soil.

Property	Unit	Value	
pH	---	7.6	
Electrical Conductivity (EC)	$ds.m^{-1}$	2.8	
N	$mg.l^{-1}$	0.59	Soil texture (Sandy soil)
P	$mg.l^{-1}$	2.56	
K	$mg.l^{-1}$	14.1	
Organic matter	%	0.92	
Soil particles (%)	%	Sand	91.4
	%	Silt	6.4
	%	Clay	3.0

First: Vegetative growth characteristics

Numbers of leaves ($leaf.plant^{-1}$), Number of branches ($branch.plant^{-1}$) were recorded.

Shoot dry weight (gm): Shoots dry weight was measured by cutting the plant at the end of the experiment and placing it in a room with good ventilation for 10 days and then placed in an electric oven at a temperature of (70 ° C) for 24 hours until it was completely dry and weighed with a sensitive balance weight. Total chlorophyll content of the leaves ($mg.100gm^{-1}$ Fresh weight), estimated by Acetone with a UV-

Visible Spectrophotometer at wavelengths of 645 and 663 nm, according to Goodwin (1976). Leaves' content of total dissolved carbohydrates (mg.gm-1 dry weight), was determined using the Duboies method (1956) at a wavelength of 490 nm using a UV-Visible Spectrophotometer.

Second: flowering growth characteristics

Number of days required for flowering (day):

The number of days required for flowering was calculated from the beginning of planting the seeds to the beginning of the emergence of flowering buds, Number of inflorescences (inflorescences.plant^{-1}). Number of florets (florets. inflorescences^{-1}).Floret diameter (cm): Diameter was measured by Vernier caliper from the two farthest points. inflorescences stem length(cm): The length of the flower was measured by a tape measure. Duration of flowering (day): The number of days required for the survival of flowers with full blooming on the plant in the field was calculated until complete withering. Anthocyanin content of florets (mg.100 g^{-1} fresh weight): The anthocyanin pigment was determined in flower petals by following Abbas and Abbas (1992) method by extracting it in a solvent consisting of ethyl alcohol and HCl (N1.5) and by means of a UV- Visible Spectrophotometer at 535 nm wavelength.

The experiment was carried out with a Randomized Complete Block Design (RCBD) in two factors with three replications. The first is to spray three concentrations of boric acid which are (0, 20 and 40 mg.l^{-1}) , second is to spray three concentrations of vitamin E which are (0, 40 and 80 mg.l^{-1}), means were compared according to the LSD test at 5% probability level(Al-Rawi and Khalaf Allah 2000).

Results:

Data in Table 2 showed a significant increase in the vegetative growth characteristics of stock plant when spraying with boric acid or spraying with vitamin E, as the number of leaves, number of branches, the dry weight of the shoots and the leaf content of total chlorophyll and total dissolved carbohydrates increased. The table also clearly showed that spraying with boric acid at a concentration of 40 mg.l^{-1} with vitamin E at a concentration of 40 mg.l^{-1} led to a significant increase in the vegetative growth characteristics as the number of leaves, number of branches, the dry weight of the vegetative total, the leaf content of total chlorophyll and total dissolved carbohydrates in leaves increased, which reached 44.69 leaves, plant^{-1} and 4.66 branches, plant^{-1}, 3.30 g, 83.30 mg, 100 g^{-1} and 8.56 mg.g^{-1} compared to the control treatment, which gave the lowest rate of 24.67 leaves.1.0 branch. plant^{-1} 1.34 g and 76.92 mg. 100 g^{-1} and 5.29 mg. 1 mg, respectively.

Table 2. Shows the effect of spraying boric acid and vitamin E and the interaction between them on vegetative growth characteristics.

Treatments			No. of leaves (leaf. plant^{-1})	No. of Branch's (Branch Plant^{-1})	Shoot dry weight (gm.)	Leaves content of Total Chlorophyll (mg.100gm^{-1} fresh weight	Leaves content of Total Soluble Carbohydrates mg. g-1) dry weight
Boric acid Mg.l^{-1}	0		26.89	1.33	1.66	77.51	5.59
	20		34.67	2.77	2.53	79.67	6.74
	40		41.67	4.22	3.21	82.84	8.30
L.S.D 0.05			0.976	0.390	0.166	0.614	0.199
Vitamin E (mg.l^{-1})	0		32.11	2.33	2.22	79.25	6.46
	40		35.67	3.00	2.45	80.19	6.97
	80		35.44	3.00	3.26	80.58	7.20
L.S.D 0.05			0.976	0.390	0.166	0.614	0.199
Boric acid × Vitamin E	0	0	24.67	1.00	1.34	76.92	5.29
		40	27.33	1.33	1.62	77.64	5.61
		80	28.66	1.66	2.03	77.99	5.87
	20	0	32.36	2.00	2.19	78.54	6.22
		40	35.00	3.00	2.44	79.50	6.75
		80	36.33	3.33	2.96	80.96	7.26
	40	0	39.00	4.00	3.15	82.30	7.88
		40	44.69	4.66	3.30	83.30	8.56
		80	41.33	4.00	3.18	82.78	8.48
L.S.D 0.05			1.690	0.676	0.288	1.064	0.346

As shown in Table 3 that spraying boric acid or vitamin E led to a significant increase in the characteristics of flowering growth, as it decreased the number of days required for flowering, an increase in the number of inflorescences, number of floret, diameter of the floret, the length of the inflorescences stem, the duration of flowering and the anthocyanin pigment. The results in the table 3 also indicate that spraying boric acid at a concentration of 40 mg. l^{-1} with spraying vitamin E at a concentration of 40 mg. l^{-1} led to a decrease in the number of days required for flowering and an increase in the number of inflorescences, number of floret, diameter of the floret, the length of the inflorescences stem, the duration of flowering and the anthocyanin pigment. It reached 134.33 days, 7.00 inflorescences. Plant^{-1}, 38.33 florets. inflorescence $^{-1}$, 1.86

cm, 30.31 cm, 25.45 days, 3.43 mg, 100 gm-1, compared to the control treatment, which gave the lowest average of 144.33 days and 4.00inflorescences.plant^{-1}, 27.67 florets. inflorescence^{-1}, 1.06 cm, 19.60 cm, 12.67 days, 1.84 mg, 100 g^{-1}, respectively.

Table 3. shows the effect of spraying boric acid and vitamin E and the interaction between them on flowering growth characteristics.

Treatments			No. of days needed for flowering (day)	No. of inflorescence (inflorescence. plant^{-1})	No. of florets (floret. Inflorescence^{-1})	Floret diameter (cm)	inflorescence stalk length (cm)	Flowering Period (day)	Anthocyanins (mg. 100 (g-1
Boric acid (mg.L^{-1})		0	143.11	4.11	28.67	1.15	20.66	13.78	2.14
		20	138.78	5.33	33.00	1.55	24.28	18.56	2.90
		40	135.33	6.44	37.67	1.78	29.09	24.78	3.34
L.S.D 0.05			0.816	0.419	0.857	0.078	0.729	0.663	0.11
Vitamin E (mg.L^{-1})		0	140.11	5.11	32.00	1.42	23.42	17.81	2.62
		40	138.56	5.33	33.11	1.48	24.83	18.89	2.87
		80	138.76	5.44	34.22	1.58	25.77	20.44	2.89
L.S.D 0.05			0.816	0.419	0.857	0.078	0.729	0.663	0.11
Boric acid × Vitamin E	0	0	144.33	4.00	27.67	1.06	19.60	12.67	1.84
		40	143.33	4.00	28.47	1.10	19.93	13.66	2.24
		80	142.00	4.33	29.25	1.30	22.43	15.00	2.33
	20	0	140.33	5.00	31.00	1.43	23.00	16.63	2.77
		40	138.33	5.00	32.33	1.56	24.27	18.33	2.94
		80	137.67	6.00	35.67	1.66	25.57	20.76	3.01
	40	0	135.67	6.33	37.33	1.76	27.67	24.00	3.25
		40	134.33	7.00	38.33	1.86	30.31	25.45	3.43
		80	136.00	6.00	37.25	1.80	29.30	24.67	3.34
L.S.D 0.05			1.413	0.726	1.485	0.135	1.263	1.148	0.206

Discussion

It is noticed from the results of Tables (2 and 3) that there is a significant increase in the characteristics under study, including the characteristics of vegetative growth. The reason is due to the important role of B in its effect on some physiological processes necessary for the plant, such as water and nutrient absorption, photosynthesis, and the movement and transport of nutrients in the plant. As well as its role in cell division and elongation for its positive effect on stimulating Auxins (Goldbach *et al* 1990). As well as its role in the process of photosynthesis and energy production (ATP), which is important in the vital processes of plants and the construction of DNA and RNA necessary for cell division. It has an important role in the transfer of sugars from the places of their manufacture to the areas of growth and the entry of this element in the composition of the cell wall and the enzymatic reactions and cell divisions of the plant cell of the meristematic tissues and its entry into the formation and manufacture of carbohydrates and protein and the transfer of carbohydrates from the places of their formation to the places of their need and the activation of building enzymes, oxidation and reduction, protein synthesis and energy transporter compounds (Andriano 1985 and Wojiek and Wojiek 2006), and thus leads to an improvement in the characteristics of vegetative growth. As well as the presence of a significant increase in the characteristics of flowering and the reason may be due to the role of B in stimulating the physiological processes in the flowering stage and increases the production of pollen grains and the growth of the pollen tube. It also increases the level of carbohydrates transported to the active growth areas during the reproductive phase. It is also due to the role of boron in the process of pollination and fertilization, then increasing the number of flowers and through increasing fertilization, thus increasing the characteristics of flowering growth (Bidwell 1979; Al-Sahaf 1989). The reason may be that B interferes with the transport of sugars in the plant as well as across the cell wall, as it interacts with the sugar molecule to be a complex, which moves through the cell membrane more easily than the sugar molecule alone and this will lead to the accumulation of quantities of sugars, which in turn increase the diameter of the flower and thus improve characteristics of flower growth (Valk *et al*. 1991 and Mostafa *et al* 1996).

It was found from the results of Tables (2 and 3) that spraying with vitamin E led to improving the characteristics of vegetative growth under study, which could be due to its important role in increasing plant cell division and the activity of a number of enzymes such as Phosphatase, β-amylase, Amylopactin and Glocosidase, or its assistance in construction of other enzymes such as Lipase, α-amylase, and Protase (Smirnoff and Wheeler 2000). The reason may be due to the increased absorption of nutrients that increase their accumulation inside the plant and thus lead to an increase in the processes of plant cell division and differentiation, as well as the preservation of chloroplast, and its effect on the carbon building process and its products (Dowdle *et al* 2007) as well as its distinguished role in activating a number of enzymes responsible for the process of carbonization, which leads to an increase in the strength of the root system, which is a center for the production of plant hormones necessary for growth, including auxins and cytokinins that have a clear effect on the strength of vegetative growth. Vitamins increase the activity of plant vital reactions that affect enzymes, and their entry into the content of plant parts leads to expansion of leaf cells and an increase in their number, thus improving the characteristics of vegetative growth (Eid *et al* 2010).

There is also a significant increase in the flowering characteristics under study, and the reason may be due to the introduction of vitamins in all enzymatic activities and the increase of biological activities and carbon building processes. As it results in an increase in vegetative growth as well as the production of amino acids and nuclei, and thus it is positively reflected on the construction of carbohydrates and their transfer from the places of their manufacture to the rest of the plant parts. Thus, building

a balance between important carbohydrates and proteins, which is reflected in the differentiation of flower buds and the increase in the number of inflorescences (Shekoofeh and Shahla 2012). In addition to the role of vitamins in encouraging vegetative growth and increasing the number of leaves and the total number of branches (Sadak *et al* 2010). The role of vitamins in protecting cell membranes and chloroplasts as antioxidants that protect plant cells from premature aging and stimulate cell division and elongation, causing an increase in the diameter of floret (Eid 2010). The reason may be due to the role of vitamins in the formation of hormones, as they act as accompaniments to plant enzymes and that the enzymes that help in speeding up and stimulating the process of water absorption and increasing the efficiency of the carbonate building process and the formation of sugars, which leads to an increase in the size of cells and their expansion and thus increase their diameter. Due to the increase in the efficiency of the process of making food by plant to grow (photosynthesis), the increase of its accumulation in the plant and its transfer to flowers, which are centers for attracting metabolism products, this positively reflected an improvement in the characteristics of flowering growth .

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