Al-Mustansiriyah Journal of Science
ISSN: 1814-635X (print), ISSN: 2521-3520 (online)
Volume 28, Issue 3, 2017
DOI: http://doi.org/10.23851/mjs.v28i3.123

Research Article

Effect of Chelating Compounds (DTPA) and Brassinolide on some Vegetative Growth Characteristics and Macroelement Content in *Corianderum sativum L.*

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ArticleInfo

Received
3 May 2017

Accepted
17 Oct. 2017

Abstract

The study was conducted at the Botanical Garden for Department of Biology, College of Education for Pure Science (Ibn Al-Haitham), University of Baghdad for the growing season (2016-2017) in order to study the chelating compound DTPA effect at different concentrations (0, 5, 10, 15, 20) mg.L^{-1} and growth organizer brassinolide at concentrations (0, 0.5, 1, 1.5, 2) mg.L^{-1} and their interaction on some morphological properties and content of macroelement (nitrogen, phosphorus, potassium) for coriander plant. Randomized complete Block Design (RCBD) was tested with three replicates. The results showed that the application by (DTPA) act to an increase in the mean of stem diameter and the total chlorophyll content in the leaves and concentration of nitrogen and potassium at the concentration of 20 mg.L^{-1} while no a significant effect on phosphorus concentration compared to the control treatment. Brassinolide increased all the studied characteristics of stem diameter, total chlorophyll content in leaves, concentration of nitrogen and concentration of potassium at concentration of 2 mg.L^{-1}, while it did not have a significant effect in phosphorus concentration compared to control treatment.

The results also showed a significant interaction between the factors of experiment in all the studied characteristics at the concentrations 20 mg.L^{-1} from DTPA and 2 mg.L^{-1} from brassinolide except of phosphorous which showed a significant interaction at concentrations 20 mg.L^{-1} from DTPA and 1, 1.5 mg.L^{-1} from brassinolide.

Key words: Chelating Compounds**,** DTPA, Brassinolide, *Corianderum sativum* L.

الخلاصـة

أجريت الدراسة في الحديقة النباتية التابعة لقسم علوم الحياة، كلية التربية للعلوم الصرفة (أبن الهيثم)، جامعة بغداد لموسم النمو (2016-2017) بهدف دراسة تأثير المركب المخلبي DTPA بالتراكيز (0, 5, 10, 15, 20) ملغم.لتر$^{-1}$ ومنظم النمو البراسينولايد بتراكيز (0, 0.5, 1, 1.5, 2)ملغم.لتر$^{-1}$ وتداخلهما في بعض الصفات المظهرية ومحتوى من العناصر الكبرى (النتروجين، الفسفور، البوتاسيوم) لنبات الكزبرة. صممت التجربة بنظام القطاعات العشوائية الكاملة Randomized complete Block Design (RCBD) وبثلاث مكررات و أظهرت النتائج ان الرش بالمركب المخلبي عمل على زيادة متوسط قطر الساق ومحتوى الكلوروفيل الكلي في الاوراق وتركيز النتروجين والبوتاسيوم عند التركيز 20 ملغم.لتر$^{-1}$ في حين لم يكن له تأثير معنوي في تركيز الفسفور مقارنة بمعاملة السيطرة , أما البراسينولايد فقد عمل على زيادة في جميع متوسطات الصفات المدروسة من قطر الساق، محتوى الكلوروفيل الكلي في الأوراق، تركيز النتروجين وتركيز البوتاسيوم عند التركيز 2ملغم.لتر$^{-1}$ في حين لم يكن له تأثيراً معنوياً في تركيز الفسفور مقارنة بمعاملة السيطرة .

كما أظهرت النتائج حصول تداخل معنوي بين عاملي التجربة في جميع الصفات المدروسة وعند التركيز 20 ملغم.لتر$^{-1}$ من المركب المخلبي و 2 ملغم.لتر$^{-1}$ من البراسينولايد ما عدا الفسفور فقد أظهرت النتائج حصول تداخل معنوي عند 20 ملغم.لتر$^{-1}$ من المركب المخلبي و (1، 1.5) ملغم.لتر$^{-1}$من البراسينولايد.

Introduction

Although the great development and tremendous progress in science but medical plants have proved to be a major source in the treatment of many diseases and become a successful alternative to many chemical

drugs [1]. The coriander plant is a medicinal and aromatic plant that is important for its essential oils. Recent studies have shown that this plant has a high antioxidant capacity [2] as well as anti-cancer [3]. Coriander is classified within the family of Apiacea [4]. Chelating compounds are tending to attract and bind some metals strongly. They can protect metal cations against sedimentation agents and thus increase their potency. Chelating compounds are usually organic compounds with a large tendency for the union with Fe, Mn, Zn, Cu and others [5].

Brassinolide is a plant steroid compound and one of the most recently discovered plant hormones belonging to the family of Brassinosteroids. Brassinosteroids were first extracted in the Brassicaceae family, previously thought to exist only in the animal kingdom [6] [7]. Recent studies have shown that brassinolide plays an important role in plant growth and development [8].

Because of the importance of coriander medical, therapeutic and food and the lack of studies of these two factors were conducted to study the effect of the interaction of these two factors in improving the growth characteristics and some chemical properties of coriander plants.

Materials and Methodology

A field experiment was conducted in the Botanical Garden belonging to the Department of Biology, College of Education for Pure Sciences (Ibn Al-Haitham), University of Baghdad, for the growth season 2016-2017. The experiment was carried out according to Randomized Complete Block Design (RCBD) and with three replicates.

The ploughing soil described in Table 1 was chartered according to the methods described [9] and divided into 75 experimental units per square meter (1 m^2). It was fertilized with NPK (Nitrogen-Phosphorus-Potassium) and the local coriander seeds were cultured at 25/10/2016 after sowing and testing the germination rate by inequity system. The distance between inequity and other was 30 cm, and began to emerge after 15 days from the date of the culture 9/11/2016 and used the following factors:

1. DTPA (0, 5, 10, 15, 20) $mg.L^{-1}$.
2. Brassinolide (0, 0.5, 1, 1.5, 2) $mg.L^{-1}$.

Table 1: Some Physical and chemical characteristic for Soil of experimental before cultured.

Character	Value	Unite
Soil texture	Clay- silt	---
Sand	228	$gm.kg^{-1}$ soil
Silt	462	$gm.kg^{-1}$ soil
Clay	310	$gm.kg^{-1}$ soil
potential of hydrogen pH)(	6.8	---
EC)(electrical conductivity	2.60	$ds.m^{-1}$
Nitrogen Ready	6.7	%
Phosphorus Ready	20.50	$mg.kg^{-1}$ soil
Potassium	380.14	$mg.kg^{-1}$ soil
Zink	150	$mg.kg^{-1}$ soil
Ferric	30.50	$mg.kg^{-1}$ soil
Manganese	300	$mg.kg^{-1}$ soil

Configurations of the soil was conducted ploughing, soften and settlement and the age of 70 and 80 days and when the early morning was application mentioned concentrations from DTPA and brassinolide on respectively. The samples took at age 100 day-old and then samples were digested and dried in the electrical oven and each sample grinded alone by electrical binder and took them 0.2 gm and digested according to the method proposed by [10] and studied the following characteristic: Stem diameter (mm): The stem diameter of five random plants was measured by using Verner calliper. Total chlorophyll content in leaves $mg.gm^{-1}$: Total chlorophyll content

was measured in the leaves of five plants at the vegetative stage of each experimental unit randomly by a Japanese Spad device. Determination of the total nitrogen content of the plant (mg.plant^{-1}): Determined according to Kjeldahl method [11].
Determination of the total phosphorus content in the plant (mg.plant^{-1}): Determination by method [12].
Determination of the total potassium content in the plant (mg.plant^{-1}): Determination by method [13].

Statistical analysis

The statistical program SAS-Statistical analysis system (2012) was used in the analysis of data to study the effect of the different factors in the studied characteristics. Significant differences were compared between the mean by the least significant difference (LSD) [14].

Results and Discussion

The results of the Table 2 showed a significant effect of the mean of stem diameter of the plant spraying by DTPA and at different concentrations, which gave concentration 20 mg.L^{-1} from DTPA highest in the mean of stem diameter reaching 1.31 mm and an increase rate 57.83% compared to the treatment of control. Attributed the reason to the role of nutrients in DTPA where these elements work to increase the growth and production of the plant where involved in the metabolic processes in the plant [15] mentioned that the best growth of the plant is achieved when the provision of major and minor nutrients at optimal levels for growth and good productivity of the plant, and thus lead to good growth for diameter of stem. As for the effect of brassinolide, results referred to the existence of a significant effect on the mean of stem diameter, the concentration 2 mg.L^{-1} superiority for brassinolide by giving the highest mean of the characteristic about 25 mm and an increase rate 37.36% compared to control treatment. This is consistent with the results [16] which showed that brassinolide works on elongation and splitting of cells and cell elongation is controlled by various processes such as coordinated changes in the mechanical properties of the cell wall, biochemical processes and gene expression. The primary wall in most plants consists of Microcellulose fibers the brassinolide assists or participates in an elasticity of cell wall, so the increase in vegetative growth resulting from the addition brassinolide may return to the elongation and cell division [17]. The results of bilateral interaction showed that there was a significant interaction between the application of DTPA and the brassinolide in the mean of stem diameter. The concentration 20 mg.L^{-1} achieved fro, DTPA and 2 mg.L^{-1} from brassinolide the highest mean 1.46 mm.

The results of Table 3 showed a significant effect on the mean of leaves content from chlorophyll. The concentration 20 mg.L^{-1} from DTPA exceeded on the compound by giving the highest total chlorophyll content 41.98 mg.gm^{-1} with an increase rate 20.49% compared to control treatment. The reason may be due to the role of DTPA or its components from microelements, such as zinc, iron and manganese, where zinc and iron act to increase the amount of chlorophyll, indirectly contributing to the metabolism of chlorophyll through its direct effect on the formation of amino acids and energy compounds [18].

The effect of brassinolide was significant in increasing the mean of total chlorophyll content in the leaves. The concentration 2 mg.L^{-1} gave the height mean was 42.98 mg.gm^{-1} with an increase rate 27.44% compared to the control treatment and this is consistent with the results [16]. The reason for the role of brassinolide in inhibiting chlorophyllase enzyme responsible for the depletion of chlorophyll, which led to the increase of chlorophyll in the leaves [19], and the brassinolides work to increase the content of chlorophyll in the leaves [20]. Nemhauser *et al.* [21] demonstrated that

there are strong links between brassinosteroid and auxin control of tissue elongation and gene regulation.

The results indicated in Table 3 that there were significant effects of application with DTPA and brassinolide and at the concentration 20 mg.L^{-1} from DTPA and 2 mg.L^{-1} from brassinolide, which gave the highest mean of chlorophyll content in the leaves, was 46.00%.

Table 2: Effect of DTPA and brassinolide and their interaction in stem diameter (cm.palnt^{-1}) for coriander plant.

brassinolide concentration (mg.L.$^{-1}$)	**DTPA concentration (mg.L.$^{-1}$)**					**Mean effect of brassinolide**
	0	5	10	15	20	
0	0.56	0.80	0.95	0.90	1.33	0.91
0.5	0.70	0.86	0.98	1.20	1.20	0.99
1	0.80	1.00	0.94	0.93	1.26	0.99
1.5	0.91	1.10	1.00	1.10	1.30	1.08
2	1.20	1.16	1.10	1.35	1.46	1.25
Mean effect of DTPA	0.83	0.98	0.99	1.10	1.31	
LSD (0.05)	DTPA: 0.267*, brassinolide: 0.267* Interaction: 0.452*					---

Table 3: Effect of DTPA and brassinolide and their interaction in total chlorophyll content mg.gm^{-1} fresh weight.

brassinolide concentration (mg.L.$^{-1}$)	**DTPA concentration (mg.L.$^{-1}$)**					**Mean effect of brassinolide**
	0	5	10	15	20	
0	20.10	28.93	39.30	38.98	40.15	33.49
0.5	30.50	30.66	39.56	38.97	38.60	35.66
1	38.98	36.41	37.96	41.25	41.50	39.22
1.5	41.98	39.32	41.11	42.54	43.63	41.42
2	42.66	39.98	42.91	41.86	46.00	42.68
Mean effect of DTPA	34.84	35.06	40.17	40.72	41.98	
LSD (0.05)	DTPA: 5.286*, brassinolide: 5.286* Interaction: 9.622*					---

The results of Table 4 showed a significant effect on the mean of nitrogen concentration in the plant under the influence of different concentrations of DTPA, where the concentration 20 mg.L^{-1} gave the highest concentration of nitrogen 3.64% and an increase rate 33.82% compared to control treatment. The reason for the increase in the mean of nitrogen concentration at the concentration 20 mg.L^{-1} from DTPA is due to the role of this compound to inhibit and build the plant hormones and enzymes and thus increase the mean of nitrogen concentration.

The results showed that there were a significant effect brassinolides on the mean of nitrogen concentration. The concentration 2 mg.L^{-1} gave the highest mean for characteristic 3.62% and an increase rate 39.77% compared to the control treatment. The plant which applied with concentration 2 mg.L^{-1} was excessed to increase nitrogen concentration because of the role of brassinolide in the increase growth of root, which improves the ability of the plant to absorb nutrients, including nitrogen [22]. This is agreement with the findings [16]. In addition, the results showed a significant effect of the application with DTPA and the brassinolide to gather. The concentration 20 mg.L^{-1} from DTPA and concentration 2 mg.L^{-1} from brassinolide gave the highest nitrogen concentration 3.95%.

The results of Table 5 indicated that there was no significant effect of phosphorus concentration on the effect of different concentrations of DTPA. There was no significant effect of phosphorus

concentration at different concentrations of brassinolide.

The bilateral interacting showed a significant effect when application with the DTPA and brassinolide together. The concentration 20 mg.L^{-1} from DTPA and concentrations (1, 1.5) mg.L^{-1} from brassinolide gave the highest mean concentration of phosphorus was 0.61%.

The results of Table 6 showed a significant effect on the mean of potassium concentration with the effect of DTPA, where the concentration 20 mg.L^{-1} from this compound gave the highest mean concentration 3.71% and an increase rate 18.91% compared to control treatment. The role of DTPA, which works to bring the microelements and increase their ability to absorb by the plant and thus increases the absorption of the macroelements, including potassium. The results showed a significant effect of brassinolide. The concentration 2 mg.L^{-1} from brassinolide the highest mean of characteristic 3.36% and an increase rate 25.33% compared to the control treatment. The reason of this an increase in mean concentration of potassium at concentration 2 mg.L^{-1} from brassinolide belong to the role of brassinolide, which effect on the physiological characteristics of crops such as stimulating the absorption of metal ions [23]. These results are consistent with [16].

The interaction had a significant effect of application with DTPA and brassinolide at concentration (20, 2) mg.L^{-1} from DTPA and brassinolide at respectively gave the highest mean of potassium concentration 4.78%.

Table 4: Effect of DTPA and brassinolide and their interaction in concentration of Nitrogen (N%) in vegetative group for coriander plant.

brassinolide concentration (mg.L.$^{-1}$)	**DTPA concentration (mg.L.$^{-1}$)**					**Mean effect of brassinolide**
	0	5	10	15	20	
0	1.88	2.30	2.45	3.15	3.20	2.59
0.5	2.80	2.63	2.85	3.25	3.60	3.03
1	2.88	2.98	2.92	3.66	3.70	3.21
1.5	2.98	3.10	3.54	3.70	3.75	3.46
2	3.06	3.51	3.61	3.91	3.95	3.62
Mean effect of DTPA	2.72	2.90	3.07	3.53	3.64	
LSD (0.05)	DTPA: 0.783*, brassinolide: 0.783* Interaction: 1.256*					---

Table 5: Effect of DTPA and brassinolide and their interaction in concentration of phosphorious (P%) for coriander plant.

brassinolide concentration (mg.L.$^{-1}$)	**DTPA concentration (mg.L.$^{-1}$)**					**Mean effect of brassinolide**
	0	5	10	15	20	
0	0.37	0.46	0.47	0.55	0.56	0 .48
0.5	0.46	0.48	0.55	0.58	0.57	0.53
1	0.44	0.59	0.48	0.49	0.61	0.52
1.5	0.48	0.42	0.53	0.59	0.61	0.53
2	0.50	0.55	0.58	0.53	0.55	0.54
Mean effect of DTPA	0.45	0.50	0.52	0.55	0.58	
LSD (0.05)	DTPA: 0.298*, brassinolide: 0.298* Interaction: 0.472*					---

Table 6: Effect of DTPA and brassinolide and their interaction in concentration of potassium (K%) for coriander plant.

brassinolide concentration (mg.L.$^{-1}$)	**DTPA concentration (mg.L.$^{-1}$)**					**Mean effect of brassinolide**
	0	5	10	15	20	
0	2.00	2.95	2.91	3.15	4.53	3.11
0.5	2.81	2.01	2.85	3.05	3.78	3.00
1	3.22	4.80	3.25	3.50	2.20	3.39
1.5	3.70	2.51	4.00	4.85	3.30	3.67
2	3.90	3.50	3.31	2.45	4.78	3.76
Mean effect of DTPA	3.12	3.15	3.26	3.60	3.71	
LSD (0.05)	DTPA: 0.552*, brassinolide: 0.552* Interaction: 0.942*					---

Conclusions

According to the results of this study, we can conclude the following.

1. The brassinolide and DTPA complex play important role in stimulating the growth of coriander plant.
2. The application treated of the brassinolide growth regulator have shown a positive effect on the growth of coriander , leading the improvement of the display and chemical qualities with a concentration exceeding 2 mg.L by giving it the highest values in most of the considered characteristics .
3. The results showed that the application by the DTPA compound led significant increase in most of the considered characteristics, the best of which was when focusing 20 mg.L.

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