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Effect of the Brassinolide and DTPA and their Interaction in Some of the Morphological Characteristics and Yield of Active Compounds in the Coriander *Coriandrumsativum* L

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Abstract: ***A field experiment was conducted in the Botanical Garden of the Department of Biology, College of Education for Pure Sciences (Ibn Al-Haitham), University of Baghdad, for the 2016-2017 growth season to study the effect of different concentrations of Brassinolide and chelating compounds DTPA and their interaction in some of the growth characteristics of the coriander Coriandrumsativum L. The experiment was carried out using the Randomized Complete Block Design (RCBD) and with three duplicates, which was used in the experience of five concentrations for growth regulator Brassinolide (0, 0.5, 1, 1.5, 2) mg.L^{-1} with application of five concentrations for chelating compound (0, 5, 10, 15, 20) mg.L^{-1}. The experiment is thus working (3 × 5 × 5), with 75 experimental units, and the experimental units will be fertilized based on their concentrations.The results obtained can be summarized as follows: 1. The results showed that the increase in the concentration of the Brassinolide has led to a significance increase in the absolute growth rate and the duration of the biomass at an increased rate 173.81%, 68.03% respectively, and has a significance effect on all active compounds of plant at concentration 2 mg.L^{-1}. 2. The results showed that the increased concentration of the chelating compoundDTPA led to a significance increase in the rate of absolute growth and biomass duration by increase of 46.77%, 38.33% respectively, and have a significance effect on all plant active compounds at 20 mg. L^{-1}. 3. The study showed that the treatment with Brassinolidehormone and DTPA and theirinteraction led to a significance increase in all studied characteristics. 4. Results ofHigh Performance Liquid chromatography (HPLC) showed eight compounds in the essential oils of coriander are: (Camphor, Limonene, Cis-dihydroxycarvone, Cymene, Linalool, Geraniol, geranyl, Alpha terpineol). The results also indicated that the two study factors had a significanceeffect on the concentration of active compounds alone as well as the interaction between them.***

Keywords: Brassinolide, DTPA, Coriander, Active compounds

1. Introduction

Medicinal plants despite the great development and tremendous progress in science, they have proven to be a prominent source of treatment for a lot of prevalent diseases at present, with its various extracts on medically active compounds and used very extensively in the development of various drugs, which have become an alternative successful for a lot of chemical drugs [1]. The recent development of its use is due to its low side effect, which the body accepts in its natural form as well as its availability and economic being [2].

Coriander is an important medicinal and aromatic plant for containing essential oils that are secondary metabolites as well as other compounds that have high anti-oxidant capacity [3]. The coriander plant is also of great importance for the elimination of cancerous diseases due to its containment of enzymatic antioxidants[4]. Experiments and research have confirmed that coriander active compounds are regulating sugarand increasing the excretion of insulin in the blood therefore is considered as alternative of a number of regulated sugar drugs as well as an organization of liver and pancreas function and functions [5].

The Bracinostroids are the sixth groups of plant hormones, which are similar to the steroidal hormone in animals [6]. The first-time Bracinostroids were extracted in the Brassicaceae family of the *Chbrassicanapus* L. pollen by [7].

Chelating compound are capable of attracting and restricting some metals strongly andcan protect metal cations against precipitation factors that lead toincreases its fitness for plants and has a large readiness for the union with cations N, Mn, Cu and other, which loses some of its ionic properties, so that it cannot participate in interactions with other soil components and remains dissolved in soil solution [8].

[9] reached to the hormone serotonin, which is deficient, causes depression and anxiety and is high in the coriander plant, so it is called the herb of happiness [10]. [10] definite the treatment with coriander plant extracts reduces mental fatigue. The plant has the ability to treat colon cancer by killing the cells type (HT-29) cancerous and therefore the work of plant extracts is to discourage the main cause of these cells, which is the (MCF-7) genetic factor of cancer [4].

The coriander oil contains many of the most active medical and industrial compounds. It contains a linalool; one of the most important and active compounds which derivative from alpha-pinine, a yellow, alcoholic clear volatile compound [11]. While Camphor is used medically to reduce thepainof arthrosis rheumatism and dilute for the trachea [12]. While the Limoneneis a hydrocarbonic compounds that has the ability to regenerate skin cells as an anti-allergic for inflammatory [13]. Studies have also shown that Limonene is an instigator of the Caspase 3 enzyme, which works to program cancerous cells to pass through cells suicidal stage [14]. The Geraniol is also an anti-cancer prostate, as it plays

an active role in cells suicidal of cancer cells, and also plays an important role in the autophagy and apoptosis for cancerous cells [15]. The Camphene, a terpenes aromatic compound, has a regulated blood glucose effect and is antithetic to high sugar [16].

While the dihydroxycarvone is the cycle volatile terpenoids ketones operates as an antioxidant and is very active and is due to the presence of the hydroxyl molecule which gain the compound highly active as an antioxidant [17], the compound uses as a tranquilizer and reduces pain, so it can be used as a sedative and a natural anesthetic without side effects [18].While Alpha-terpineol is used to kill cancer cells and stimulates the death of programmed cells in liver cancer patients and also acts as an anti-breast cancer, preventing the compound to provide the tumor with glycoproteins which the most important factors of cancer growth, as this compound is combined with these proteins and is quickly metabolize to easily fragmented alcoholic proteins [19].

Accordingly, the idea of conducting the present study was to:

1) Study the effect of application with Bracinostroid and DTPA and determine the optimal concentration for both.
2) Study the effect of application with Bracinostroid and the chelating compounds in the studied characteristics.
3) Extraction and diagnosis of coriander oil active compounds under the influence of study factors.

2. Materials and Methods

2.1 Location of experiment conducted

A field experiment (3×5×5) was carried out 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 to study the effect of the Bracinostroid and DTPA and their interaction in some of the chemical and physiological characteristics of Coriander *Coriandrumsativum* L. plant. The seeds were obtained from local markets. Some chemical and physical characteristics were estimated in a soil sample prior to cultivation according to the methods described in [20].

Table 1: Some Physical and chemical characteristic for experimental soil before cultured

Character	Value	Unit
Clay	310	gm.kg^{-1} soil
Silt	462	gm.kg^{-1} soil
Sand	228	gm.kg^{-1} soil
Soil texture	Clay-silt	---
potential of hydrogen (pH)	6.8	---
electrical conductivity (EC)	2.60	ds.m^{-1}
Nitrogen available	0.67	%
Phosphorus available	20.50	mg.kg^{-1} soil
Potassium available	380.14	mg.kg^{-1} soil
Ferric	30.50	mg.kg^{-1} soil
Zink	150	mg.kg^{-1} soil
Manganese	300	mg.kg^{-1} soil

The experiment was designed by R.C.B.D. (Randomized complete Blocks Design) and by three replicates included (75) experimental units, with each repeating of 25 experimental units and repeating area was (7×7) meter and then the total of the experimental units was 75 experimental units, with the area of the experimental unit 1 m^2, each experimental unit contains 4 straight lines between the line and the last 30 cm and the distance between the plants 15 cm.

The fertilizer NPK 20:20:20 for all experimental units in the first two batches before cultured and the second after 50 days of cultured on the basis of the fertilized recommendation (90 kg. Ha^{-1}), the seeds were then planted on the date of 25/10/2016 after they were grating and their germination rate was tested.

2.2 Studied characteristics of coriander plant:

2.2.1. Absolute growth rate (g. Day^{-1}) by method [21]:

$$\text{Absolute Growth Rate} = \frac{W_2 - W_1}{T_2 - T_1}$$

Science:
W1 = dry weight of the vegetative group (gm) at the first harvesting.
W2 = dry weight of the vegetative group (gm) at the second harvesting.
T1 = age of the plant (day) at the first harvesting.
T2 = age of the plant (day) at the second harvesting.

2.2.2. Biomass Duration (gm. Day^{-1})

Taking the biomass duration according to[22]:

$$\text{Biomass Duration} = \frac{(W_1+W_2)T_2-T_1}{2}$$

W1, W2 = dry weight of the vegetative group for each harvesting.
T1, T2 = age of the plant at the first and second harvesting

2.2.3. Separation of the active compounds of the essential oil of the coriander plant using a High-performance Liquid chromatography (H.P.L.C.)

Medically active compounds were diagnosed in coriander plant by method [23].

2.3. Statistical analysis

The SAS (2012) was used in the analysis of data to study the effect of different factors in the studied characteristics, and the significance differences between the averages were compared with the lowest significance difference (LSD) test [24].

3. Results and Discussion

3.1. Absolute growth rate (gm. Day^{-1})

The results of the table (2) indicated that there were significant differences in the absolute growth rate for the effect of the application of the Bracinostroid at different concentrations. The concentration 2 mg. L^{-1} gave highest rate of the characteristic was 1.15 gm. Day^{-1} with an increase of 173.81% compared to the control treatment of 0.42 gm. Day^{-1}, this increase in the rate of absolute growth resulted by the increase in the morphological characteristics of coriander plant, as the increase in these character increases the rate of absolute growth and this is consistent with [25, 26].

The effect of the application of the DTBA with different concentrations was significant in absolute growth rate of plant. The concentration 20 mg. L^{-1}gavethe highest average rate of 0.91 gm. Day^{-1} with an increase of 46.77% compared with treatment of control; maybe it is belong to the role of the DTBA compound in increasing plant growth, which has been positively reflected in the absolute growth rate.

As for interaction, there is a significance effect on the absolute growth rate of plant, with the best effect of the interact being between concentrations 2 mg. L^{-1}Bracinostroidand 20 mg. L^{-1} DTBA compound by giving it the highest value of this character to 1.20 gm. Day^{-1} with an increase of 900.00% compared to the treatment of control.

Table 2: The effect of the Bracinostroid and the DTPA compound and their interaction in the absolute growth rate (gm. Day^{-1}) for coriander plant

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	**5**	**10**	**15**	**20**	
0	**0.12**	**0.18**	**0.60**	**0.54**	**0.65**	**0.42**
0.5	**0.20**	**0.53**	**0.81**	**0.92**	**0.75**	**0.64**
1	**0.35**	**0.65**	**0.68**	**0.88**	**0.90**	**0.69**
1.5	**1.05**	**0.98**	**0.95**	**0.95**	**1.05**	**1.00**
2	**1.40**	**1.05**	**1.06**	**1.06**	**1.20**	**1.15**
Mean effect of DTPA	**0.62**	**0.67**	**0.82**	**0.87**	**0.91**	
LSD (0.05)	DTPA= *** 0.492**, Bracinostroid=*** 0.492** Interaction= *** 0.772**					----

3.2. Biomass duration (gm.Day^{-1})

The results of table 3 showed that there were significant differences in the average of biomass duration by the effect of the application of the Bracinostroid at difference concentrations. The concentration 2 mg. L^{-1} has the highest average of this character 1603.04 g. Day^{-1} with an increase of 68.03% compared to the treatment of control, it amounted to 954.04 gm. Day^{-1}. This increase in the average biomass is due to the role of the Bracinostroid in increasing vegetative growth, which leads to an increase in the average of biomass duration and is consistent with the results of [26].

As to the effect of the applicationwith DTBA compound by the different concentrations, the results indicate that there are significant differences in the average of biomass duration.The concentration 20 m. L^{-1} giving thehighest an average of 1386.88 g. Day^{-1}, with an increase of 38.33% compared with the treatment of control. The reason for the role of the DTBA compound to increase vegetative growth and thus increase the average of character.

As for interaction, it had a significance effect on the average of biomass duration, with the highest interact being between concentration 2 mg. L^{-1}Bracinostroidand 20 mg. $L^{-1}$of DTBA compound by giving it the highest value for this characteristic amounted to 1705.00 g. Day^{-1} with an increase of 178.59% compared to the treatment of control.

Table 3: The effect of the Bracinostroid and the DTPA and their interaction in the average of biomass duration (gm. Day^{-1}) for coriander plant

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	**5**	**10**	**15**	**20**	
0	**612.00**	**855.80**	**1441.40**	**758.20**	**1102.80**	**954.04**
0.5	**652.40**	**1021.60**	**1275.40**	**1467.00**	**1108.80**	**1105.04**
1	**1336.60**	**882.40**	**1056.60**	**1413.00**	**1614.80**	**1260.68**
1.5	**1206.00**	**966.45**	**1084.40**	**1417.80**	**1403.00**	**1215.53**
2	**1206.00**	**1524.20**	**1522.20**	**1438.60**	**1705.00**	**1603.04**
Mean effect of DTPA	**1002.60**	**1050.09**	**1276.00**	**1298.92**	**1386.88**	
LSD (0.05)	DTPA= *** 71.963**, Bracinostroid=*** 71.963** Interaction= *** 127.504**					---

3.3. The effect of the Bracinostroid and DTPA compound and their interaction in some active compounds in the essential oil of the coriander plant

The results of the tables (4, 5, 6, 7, 8, 9, 10, 11) showed that the essential oil of the coriander plant contained eight effective medical compounds in their essential oil of the coriander plant which are:

(Camphor, Limonene, Cis-dihydroxycarvone, Cymene, Linalool, Geraniol, Geranylacetate, Alphaterpineol).

The results of the tables also showed that there were significant differences in the average concentration of active compounds in the fruits of the coriander plant with the effect of different concentrations of Bracinostroid, as the average concentration of the effective compounds increased by increasing concentrations from 0 to 2 mg. L^{-1}. The concertation 2 mg. L^{-1} giving the highest value 459.16% 515.31%, 186.18%, 447.67%, 1208.16%, 562.45%, 396.41%, 105.85% at respectively and by increase average 938.82%, 1191.50%, 451.81% and 1047.28%, 206.08%, 1300.87%, 527.53%, and 201.22% at respectively on a comparable with non application with Bracinostroid. The superiority of the application plants with concentration 2 mg. L^{-1} in increasing the concentration of active compounds is due to the role of the Bracinostroid, which is essentially a derivative of the secondary metabolism in the medicinal plants, and patriated as product from oils compounds in the metabolism of sterol [27]. The hormone has a role in increasing the vegetative and repoductive growth by the increase of the other cellular divisions and coding of nucleic acid and cyclins synthesis which are phosphoprotein have high active in increasing of cellular division specially Cyclin

Dependent Kinase enzymes (CDK)[28]. In addition, the Bracinostroidhas an important role to play in the metabolite of mevalonic acid and then increase the production of the gibberellin and the hormone increases the transformation of mevalonic acid to dimethylallyl pyrophosphate (DMAPP) compound, which increases the production of terpenes oils and aromatic oils [17].As also due to the increase active compounds to the fact that Bracinostroid is a steroidal hormone which is one of the products of the terpenes metabolites which forming the high part of the active compounds of coriander oil [29] and correspond to the results [25].

As to the effect of application with the DTBA compound by different concentrations, the results are significant differences in the average concentration of active compounds in the fruits of the coriander plant. The concentration 20 mg.L^{-1} giving the highest average of active compound 277.55%, 476.44%, 229.65%, 368.41%, 1416.47%, 554.59%, 296.38% and 106.56% respectively and an increasing rate, 185.40%, 551.32%, 390.71%, 376.66%, 385.59%, 903.24%, 113.05%, and 113.46% respectively compared to control treatment. The increase in average character is due to the role of DTBA compound and its link to the microelement and increased absorption by the coriander plant as zinc enters the formation of tryptophan which is the important in the synthesis of the alkaloids [30]. As the reason for the role of iron as coenzyme for some of the vital interactions that occur within the plant, which in turn will be formation the secondary products that enter into the formation active compounds in medicinal plants [31]. The increase in active compound is also due to the role of manganese, which enters in the formation of amino acids [32], this will further stimulate the synthesis of active compounds in medicinal plants.

The bilateral interaction between the Bracinostroid and the DTBA compound was significantly in the concentration of the active compounds. The treatment of 2 mg. L^{-1} from Bracinostroid and 20 mg. L^{-1} of the DTBA compound aresignificant increase in the concentration of all active compounds at 689.16%, 110.47%, 395.50% and 877.46%, 3053.99%, 2078.09%, 594.10%, 130.13% respectively and an increase rate of 6131.10%, 6061.65%, 1817.11%, 2699.81%, 2017.30%, 11647.26%, 929.46%, and 849.85% respectively compared with control treatment.

Table 4: The effect of Bracinostroid and the DTBA compound and their interaction in the average camphor ratio (%) in the essential oil of the coriander plant

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	11.06	45.69	48.39	55.69	60.19	44.20
0.5	60.39	70.83	74.60	86.37	89.82	76.40
1	70.93	80.27	80.75	118.24	156.96	101.43
1.5	108.31	110.55	122.45	126.28	391.60	171.84
2	235.55	345.76	427.97	597.38	689.16	459.16
Mean effect of DTPA	97.25	130.62	150.83	196.79	277.55	
LSD (0.05)	DTPA= *21.74, Bracinostroid= * 21.74 Interaction= * 36.45					---

Table 5: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of limonene (%) in the essential oil of the coriander plant.

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	17.86	24.70	28.50	58.47	69.97	39.90
0.5	50.83	60.09	96.23	115.92	291.85	122.98
1	52.85	55.95	59.01	61.32	306.49	170.12
1.5	80.50	96.92	110.05	125.79	613.40	205.33
2	163.69	220.58	330.48	761.35	1100.47	515.31
Mean effect of DTPA	73.15	91.65	124.85	224.57	476.44	
LSD (0.05)	DTPA= *41.97, Bracinostroid=* 41.97 Interaction= *71.69					---

Table 6: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of dihydroxycarvone (%) in the essential oil of the coriander plant.

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	20.63	22.35	30.55	44.41	50.75	33.74
0.5	29.89	58.30	102.11	117.57	126.37	86.85
1	40.19	70.50	70.82	240.34	252.50	134.87
1.5	60.46	65.54	163.06	170.00	323.15	143.84
2	82.84	86.10	180.60	185.86	395.50	186.18
Mean effect of DTPA	46.80	60.56	109.43	151.64	229.65	
LSD (0.05)	DTPA= *18.55, Bracinostroid=* 18.55 Interaction= * 32.73					---

Table 7: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of Cymene (%) in the essential oil of the coriander plant.

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	31.34	34.89	40.70	43.13	45.04	39.02
0.5	66.34	101.86	170.73	190.13	210.57	147.93
1	68.43	116.39	194.17	197.56	250.30	165.37
1.5	80.22	95.80	287.96	295.30	458.70	243.60
2	140.12	162.76	217.34	840.67	877.46	447.67
Mean effect of DTPA	77.29	102.34	182.18	313.36	368.41	
LSD (0.05)	DTPA= *38.63, Bracinostroid= * 38.63 Interaction= * 66.25					---

Table 8: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of Linalool (%) in the essential oil of the coriander plant.

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	144.24	229.20	249.31	520.20	830.66	394.72
0.5	145.00	154.88	420.50	422.01	922.43	412.96
1	350.20	431.10	473.10	578.50	953.94	557.37
1.5	359.02	626.05	850.87	1137.42	1321.35	858.94
2	460.03	602.50	610.16	1314.13	3053.99	1208.16
Mean effect of DTPA	291.70	408.75	520.79	794.45	1416.47	
LSD (0.05)	DTPA= *83.57, Bracinostroid=* 83.57 Interaction= * 133.94					---

Table 9: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of Geraniol (%) in the essential oil of the coriander plant

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	17.69	27.64	31.94	40.80	82.66	40.15
0.5	33.73	105.37	136.00	145.80	148.26	113.83
1	71.01	150.44	192.89	198.65	223.17	167.23
1.5	75.66	218.32	220.83	235.10	240.78	198.14
2	78.29	109.65	225.23	320.97	2078.09	562.45
Mean effect of DTPA	55.28	122.28	161.38	188.26	554.59	
LSD (0.05)	DTPA= *86.21, Bracinostroid=*86.21 Interaction= *147.04					---

Table 10: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of Geranylacetate(%) in the essential oil of the coriander plant.

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	57.71	58.89	59.28	59.49	80.47	63.17
0.5	58.52	80.83	83.46	87.96	90.54	80.26
1	77.84	78.10	150.40	158.64	266.70	146.34
1.5	224.95	310.10	433.71	448.03	450.09	373.38
2	276.51	243.01	311.75	556.69	594.10	396.41
Mean effect of DTPA	139.11	154.19	207.72	262.16	296.38	
LSD (0.05)	DTPA= *28.61, Bracinostroid=*28.61 Interaction= *51.77					---

Table 11: The effect of Bracinostroid and the DTBA compound and their interaction in the average percentage of Alphaterpineol (%) in the essential oil of the coriander plant.

Bracinostroid concentration (mg.L^{-1})	DTPA concentration (mg.L^{-1})					Mean effect of Bracinostroid
	0	5	10	15	20	
0	13.70	16.67	18.50	30.96	95.88	35.14
0.5	50.08	90.83	91.73	95.64	97.80	85.22
1	53.10	87.50	95.21	98.59	98.92	86.66
1.5	60.45	70.50	91.47	107.30	110.09	87.96
2	72.26	90.24	116.12	120.50	130.13	105.85
Mean effect of DTPA	49.92	71.15	82.61	90.60	106.56	
LSD (0.05)	DTPA= * 14.86, Bracinostroid=* 14.86 Interaction= * 25.79					---

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