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THE EFFECT OF GIBBERELLIN AND TRYPTOPHAN ON SOME VEGETATIVE AND QUALITATIVE CHARACTERISTICS OF SWEET BASIL

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Abstract

An experiment was conducted to study the effect of three concentrations of gibberellin and tryptophan in some vegetative and qualitative characteristics of sweet basil (*Ocimum basilicum* L.). Results showed that the 150mg.L^{-1} concentration of gibberellin was significantly higher in all studied characteristics when it gave the highest average of plant height, number of leaves, number of side branches, leaves content of total chlorophyll, camphor and linalool. The spraying of 150mg.L^{-1} concentration of tryptophan acid was also gave the highest average of plant height, number of leaves, number of side branches and leaves content of total chlorophyll. While spraying sweet basil plants with 75mg.L^{-1} concentration of tryptophan acid was gave the best results in leaves content of camphor and linalool compare to control treatment in both factors. The interaction between 150mg.L^{-1} concentration of gibberellin and 150mg.L^{-1} concentration of tryptophan acid treatments was reached the highest average in all studied characteristics.
***Keywords*:** *Ocimum basilicum*, gibberellin, tryptophan acid, linalool.

Introduction

Sweet basil (*Ocimum basilicum* L.) is one of lamiaceae (labiateae) family members that include a large number of aromatic plants widespread globally (Paton, 1992). This plant genus comprised of more than 200 species and a number of varieties naturally common and native in tropics of Asia and Africa (Lawrence, 1992). Basil species are distinguished by containing many medicinal properties, including antioxidant, antimicrobial and antitumor activities which occurs as a result of presence of phenolic acids and aromatic compounds (Hussain *et al.*, 2008). *O. basilicum* is used also in some industries such as perfumes, soap, shampoo, toothpaste and various cosmetics because it contains a high percentage of esters (Simon *et al.*, 1990). The oil of basil contains many active compounds that used in a number of economic fields, whether they are food, industrial or pharmaceutical products of which the most important linalool, cinole, eugenol and tryptophan (Anon, 1980).

Gibberellins are plant growth regulators that have an important and necessary role for plants, as they work to simulate and activate the processes of dividing and expanding cells. It also activates many necessary enzymes that contribute in plant growth, development and increase the activity of various biological and physiological processes of the cell by increasing the building of DNA, RNA and proteins. In addition, gibberellins increase the water content of cells and control the permeability of cell walls (Hopkins and Hüner, 2004). Terpenes are considered as a physiological starter of indole acetic acid (IAA) and its use in appropriate concentrations, as it has a positive effect on plant growth due to the continuous and slowly release of IAA from tryptophan (Zahir *et al.*, 2000). Moreover, tryptophan have an essential role in stimulating plant growth and its effect on oxygen synthesis. Spraying with this acid works to increase plant height levels, number of branches, soft and dry weight and increase the yield by increasing spraying level of tryptophan acid (Abdel Aziz *et al.*, 2009).

Materials and Methods

The experiment was conducted in private field located in Najaf province in 2019 season. Complete block randomized design RCBD was used with three replicates for each treatment and two main factors. The first factor was spraying basil leaves with three concentrations of gibberellin (0, 75 and 150mg.L^{-1}) and the second factor was spraying basil leaves with same concentrations of tryptophan. Two sprayings of these factors were applied during the agriculture season, the first spray was applied in 29/5/2019 then the second spray was applied after 10days of the first one. The least significant difference (L.S.D.) was used to compare means at 5% level of significance ($P>0.05$) (Al- Rawi and Khalf, 2000). Field was divided into 3 blocks; each block contains 9 experimental units measured 4m^2 (2 x 2m). Three basil seeds were planted together on lines in each plot; the distance between these lines was 30cm and between each plant was 10cm then seedlings were thinned to one plant (Respondek and Zvalo, 2008). Data of plant height (cm), number of leaves (leave.plant^{-1}) and number of side branches (branch.plant^{-1}) were recorded. Leaves content of total chlorophyll (mg.100g^{-1} fresh weight) and camphor and linalool% were measured using Hcini *et al.* (2013) procedure.

Results and Discussion

Results showed that the 150mg.L^{-1} concentration of gibberellin had significant effect in all studied vegetative characteristics (plant height, number of leaves and number of side branches) which recorded 74.3cm, 237 leave.plant^{-1} and 15.93 branch.plant^{-1} respectively compare to 55, 120 and 9.51 in control treatment (Table 1). While the 150mg.L^{-1} concentration of tryptophan acid reached the highest average in all studied characteristics and gave 71.6cm, 237.66 leave.plant^{-1} and 15.37 branch.plant^{-1} respectively compare to 55.7, 125 and 12.24 in control treatment. The interaction between 150mg.L^{-1} concentration of gibberellin and 150mg.L^{-1} concentration of tryptophan acid treatments was reached the highest average in vegetative characteristics and gave 85.9cm, 327 leave.plant^{-1} and 18.40 branch.plant^{-1}

respectively compare to 53.1, 88 and 7.27 in control treatment.

The significant effect on vegetative characteristics of basil that achieved by different concentrations of gibberellin may occurred due to the role of gibberellins which considered plant growth regulators that have an important and necessary role for plants, as they work to simulate and activate the processes of dividing and expanding cells. It also activates many necessary enzymes that contribute in plant growth, development and increase the activity of various biological and physiological processes of the cell by increasing the building of DNA, RNA and proteins. In addition, gibberellins increase the water content of cells and control the permeability of cell walls (Hopkins and Hüner, 2004). These findings are in agreement with Mehraj *et al.* (2014) who reported that the spraying of different concentrations of gibberellin (0, 100 and 200 ppm) on *Solanum lycopersicum* var. *cerasiforme* had significant effect in most studied traits and the 200ppm concentration gave the highest plant height, number of leaves, number of fruits in each plant, the average of each fruit and total yield in unit area compare to control treatment. Nahed *et al.* (2010) found that the effects of tryptophan on plants play an essential role in stimulating plant growth and its effect on oxygen synthesis. Moreover, spraying with this acid works to increase plant height levels, number of branches, soft and dry weight and increase the yield by increasing spraying level of tryptophan acid. The external use of tryptophan acid has major role on increasing and improving the productivity of many agricultural crops (Zahir *et al.*, 2005).

Table 1 : The effect of gibberellin and tryptophan and their interaction on studied vegetative characteristics (plant height, number of leaves and number of side branches).

Gibberellin ($mg.L^{-1}$)				**Average of tryptophan ($mg.L^{-1}$)**
Plant height (cm)				
Average of tryptophan	**150**	**75**	**0**	
55.7	58.7	55.3	53.1	0
64.4	78.3	61.9	53.1	75
71.6	85.9	69.9	58.9	150
	74.3	62.4	55.0	Average of gibberellin
Gibberellin= 5.42 Tryptophan= 5.42 Interaction= 9.39				L.S.D (5%)
Number of leaves. $Plant^{-1}$				**Tryptophan ($mg.L^{-1}$)**
Average of tryptophan	**150**	**75**	**0**	
125	181	106	88	0
167.33	203	178	121	75
237.66	327	236	150	150
	237	173	120	Average of gibberellin
Gibberellin= 53.6 Tryptophan= 53.6 Interaction= 92.9				L.S.D (5%)
Number of side branches. $Plant^{-1}$				**Tryptophan ($mg.L^{-1}$)**
Average of tryptophan	**150**	**75**	**0**	
12.24	15.27	14.20	7.27	0
13.17	14.13	14.87	10.53	75
15.37	18.40	17.00	10.73	150
	15.93	15.35	9.51	Average of gibberellin
Gibberellin= 1.813 Tryptophan= 1.813 Interaction= 3.140				L.S.D (5%)

Results of Table 2 showed that the 150$mg.L^{-1}$ concentration of gibberellin had significant effect on total chlorophyll, camphor and linalool and recorded the highest average of these traits which reached 68.44$mg.100gm^{-1}$fresh weight, 22.917% and 5.562% respectively in comparison with 79.67 $mg.100gm^{-1}$fresh weight, 16.285% and 2.778% for control treatment. The 150$mg.L^{-1}$ concentration of tryptophan was achieved the highest leaves content of total chlorophyll and reached 88.89 $mg.100gm^{-1}$fresh weight compare to 79.89 in control. While the 75$mg.L^{-1}$ concentration gave the highest average of leaves content of camphor and linalool which recorded 19.917% and 4.246% respectively compare to 16.975% and 3.136% in control. The interaction between 150$mg.L^{-1}$ concentration of both gibberellin and tryptophan acid treatments was reached the highest average in total chlorophyll, camphor and linalool and recorded 92.33 $mg.100gm^{-1}$fresh weight, 23.315% and 6.346% respectively in comparison with 77.67 $mg.100gm^{-1}$ fresh weight, 12.735% and 1.717% in control treatment.

Gibberellin was significantly affecting the quantitative traits of sweet basil (total chlorophyll, camphor and linalool). This effect occurred due to the fact that gibberellin is widely used commercially and its ability to improve vegetative growth of plant by simulating and activating the processes of dividing and expanding cells, increase the elasticity of its walls and delay the aging of leaves. This in turn delays the destruction of chlorophyll, protein and RNA and increases its construction (Taiz and Zeiger, 2010). In addition, gibberellin has a role in preventing the destruction of chlorophyll by activating chlorophyllase enzyme, increasing the proportion of nitrogen in leaves which considered the main element in the formation of amino and nucleic acids and energy compounds (ATP, NADPH2 and NADH2) that cause increasing in vegetative growth(Hopkins and Hüner, 2004). Moreover, gibberellins are distinguished by increasing the absorption ions and improve its distribution to the root system when added to plants in different stages of growth (Iqbal and Ashraf, 2013). This in turn reflects on increasing of water content in plants and this result is I agreement with Povah and Ono, (2007) who found that adding gibberellin to *Salvia officinalis* L. was affected chemical contents, and with Rahman *et al.* (2015) who reported that spraying different concentrations of gibberellin (0, 25, 50, 75 and 100ppm) on

(*Lycopersicon esculentum* Mill.) leaves had significantly affected chlorophyll and protein level.

The significant effect of tryptophan is occurred due to its starter (Indole-3-glycerol phosphate) which considered the starter of acetic acid formation that has 4 vital pathways for its formation in plant. Three of these pathways depend on tryptophan acid (Tryptophan-dependent Auxin biosynthesis) (Kobayashi *et al*., 1995; Mano and Nemoto, 2012). Salama and Rania, (2015) also found that spraying of amino acids and seaweed extract on holy basil leaves was affected the chemical content of plant leaves.

Table 2 : The effect of gibberellin and tryptophan and their interaction on total chlorophyll, camphor and linalool of sweet basil leaves.

Gibberellin ($mg.L^{-1}$)				**Average of tryptophan ($mg.L^{-1}$)**
Plant height (cm)				
Average of tryptophan	**150**	**75**	**0**	
79.89	83.67	78.33	77.67	0
82.78	83.33	87.33	77.67	75
88.89	92.33	90.67	83.67	150
	86.44	85.44	79.76	Average of gibberellin
Gibberellin= 2.469 Tryptophan= 2.469 Interaction= 4.277				L.S.D (5%)
Leaves content of camphor%				**Tryptophan ($mg.L^{-1}$)**
Average of tryptophan	**150**	**75**	**0**	
16.975	20.840	17.350	12.735	0
19.917	22.275	17.795	19.680	75
19.563	23.355	18.895	16.440	150
	22.157	18.013	16.285	Average of gibberellin
Gibberellin= 0.3658 Tryptophan= 0.3658 Interaction= 0.6382				L.S.D (5%)
Leaves content of linalool%				**Tryptophan ($mg.L^{-1}$)**
Average of tryptophan	**150**	**75**	**0**	
3.136	4.932	2.757	1.717	0
4.246	5.407	3.187	4.142	75
4.156	6.346	3.646	2.467	150
	5.562	3.197	2.778	Average of gibberellin
Gibberellin= 0.0848 Tryptophan= 0. 0848 Interaction= 0.1341				L.S.D (5%)

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