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THE EFFECT OF PHOSPHORUS AND SPRAYING WITH TRYPTOPHAN ON SOME OF THE SHAPE AND PHYSIOLOGICAL CHARACTERISTICS OF THE CORIANDER PLANT (*CORIANDRUM SATIVUM* L.)

Hind Kamel Kareem Salem Al-Whaili* and Bahaddin Makki Fairuz Al-Rubai'i

Department of Science, College of Basic Education, Mustansiriyah University, Baghdad, Iraq

Abstract

A field experiment was conducted in the botanical garden of the Department of Science-College of Basic Education/Al-Mustansiriyah University for the winter growing season 2018-2019 to know the effect of the increasing concentrations and levels of each of the growth organizer tryptophan and the phosphorus fertilizer and the overlap between them on some shape and physiological characteristics of coriander plant (*Coriandrum sativum* L.).

The coriander seeds were planted on 15/11/2018 with conducting all agricultural processes including irrigation and fertilization, removing the bushes and following-up the growth of the plant until the harvest date.

The phosphorus fertilizer was added in three levels (0, 30 and 60) kg.h^{-1} as well as adding three concentrations of tryptophan acid (0, 5 and 10)mg.L^{-1}. The experiment was designed according to the Randomized Complete Block Design (R.C.B.D) and thus it included (27) experimental units, each with an area of one square meter and it became a factor experiment (3×3×3).

***Key words*:** Coriander, phosphorus, tryptophan.

Introduction

Coriander plant (*Coriandrum sativum* L.) is one of the plants of the apiaceae umbelliferae family. It is an annual herb, its trunk is right with branches, its leaves are structured, its flowers are pinky white and exist in umbrella beams, its fruits are binary round and collected when their color turns into light brown (Al-Qazzaz, 2016). The coriander plant is characterized by containing many essential aromatic oils which are considered as one of the secondary metabolism compounds as well as many other compounds. The modern studies proved that the plant has a natural anti-oxidation ability (Nadeem *et al*., 2013). The plant seeds contain various quantities of carbohydrate, fats, proteins, vitamins, nutritional fibers, mineral elements, as the coriander leaves contain a moisture of 87.9%, protein 3.3%, fats 0.6%, carbohydrate 6.5%, mineral materials 1.7%, the components of volatile oil of coriander oil and linalool 67.7%, Alpha-pinene 10.5%, Gama Trebnin 0.9%, geranile acetate 0.4%, Camphor 0.3% and Geraniol 1.9% (Al-Saadi *et al*., 2013).

The coriander is one of the aromatic plants and wind disposer. It strengthens the stomach, prevents diarrhea, works on strengthening the heart, decreases blood pressure for containing a large percentage of Iodine, in addition to other many advantages. The volatile oil is also used to improve the taste and smell of the medicines and enters in making cosmetics, perfumes and soaps (Al-Attabi, 2018).

One of the characteristics of coriander active compounds is organizing the sugar in blood and are considered as an alternative to many drugs that organize the sugar, as the experiments proved that they work on increasing the insulin release in blood as well as organizing the activities of liver and pancreas functions (Asyarpanah and Kazemivash, 2012, Frederico *et al*., 2016).

Phosphorus is one of the major elements needed by the plants in large quantities for its important role in improving the morphological characteristics, increasing the fruits and the active material, working on the production and the increase of volatile oils and the secondary metabolism compounds (Al-Ni'aimi, 2008, Jan *et al*., 2011).

It is also considered as one of the elements with a direct role in affecting most of the physiological processes

***Author for correspondence :** E-mail: ms.bio2012@yahoo.com

occurring inside the plant, as it participates in decomposing the carbohydrates resulted from the photosynthesis and releasing the energy required for the construction processes as well as its role in forming the cellular membranes (Blevian, 2001). The plants need phosphorus in relatively large quantities for essential and secondary bio-synthesis and due to its importance in the necessary functions as an essential factor for nuclear acids and phospholipids in addition to its fundamental role in the metabolism energy of cells (Nellmonika *et al*., 2009).

The tryptophan is one of the amino acids of (8-amino, b-indole heterocyclic propioic acid) type (Jain, 2011), as it is synthesized in the cycle of phosphorous peptoes, converted into hexose monophosphate shunt (HMS), or the direct oxidation path which is the base to build the auxin in the plant in which the zinc element enters its structure. It was found that treating the plants with tryptophan will improve the plants growth and yield for being the basic brick to form the auxin (Zahir, 2000).

The tryptophan was used in helping the corn to bear the drought in different concentrations and the concentration (15) factions in million gave better results in improving the plant growth (Rao, 2012).

The tryptophan is also known as B-indolylanine. It is also considered as the origin of the main bio-construction of auxin in plants, *i.e.* the Indol Acetic acid. It also exists in the plants in the form of amino acid free or associated with protein and its quantity in the leaves is around (20-40) microgram for each gram of wet weight more than the quantity of IAA in about 1000 times (Al-Aani, 1991).

Materials and Methods

The experiment was conducted in the botanical garden of the Department of Science-College of Basic Education/Al-Mustansiriyah University to study the effect of the increasing concentrations and levels of each of the phosphorus and tryptophan and the overlap between them on some shape and physiological characteristics of coriander plant (*Coriandrum sativum* L.). The experiment was designed according to the randomized Complete Block Design (R.C.B.D).

The experiment included the following:

1. Three levels of phosphorus (0, 30 and 60) kg.h^{-1}. The fertilizer quantity was weighed for each level relying on the area of the one experimental unit and according to the treatments in the experiment, as it was added in pieces beside the plant in the shape of (NPK) fertilizer as well as the zero level which is considered as a control treatment.

2. Three concentrations of the growth organizer tryptophan (0.5, 10) mg.L^{-1} prepared relying on the dilution law from the stock solution prepared by solving one gram of tryptophan in one liter of distilled water so as to have a standard solution with a concentration of 1000mg.L^{-1}.

Samples were taken from the field soil before planting for the purpose of estimating some chemical and physical characteristics according to the described methods in (Page *et al*., 1982) and as shown in table (1).

The Studied Characteristics

• Shape Characteristics:

The Plant Height (cm): The plant height was measured when the plants reach the green growth stage for each experimental unit of land surface and till the highest point of the plant.

The Dry Weight of the Green Aggregate (gm): Three plants were taken from each experimental unit according to the dry weight after drying them in an electric furnace for 48 hours at 60^{o}C.

The Number of Main Branches of the Plant: The number of main branches formed from the main trunk was calculated.

Physiological Characteristics

Estimating the Aggregate Chlorophyll Content (microgram.cm^{2}): The aggregate chlorophyll was estimated in the growing plant leaves in the field at the

Table 1: Some chemical and physical characteristics of the study soil.

Characteristic	Value	Unit
Electric conductivity EC $_{1:1}$	1.9	Ds.m^{-1}
Reaction degree pH$_{1:1}$	7.9	
Organic material O.M	18	g.kg^{-1}
Carbonate minerals	233	g.kg^{-1}
Soluble ions		meq.L^{-1}
Ca^{+2}	10	
Mg^{+2}	6.2	
Na^{+}	3.1	
K^{+}	0.73	
HCO^{-3}	9.1	
Co_3^{-2}	Nil	
Cl^{-}	6.7	
SO_4^{-2}	3.8	
Available nutrients		Mg.kg^{-1}
N	35	
P	16.6	
K	138.6	
Soil Separates		g.kg^{-1}
Sand	99	
Silt	735	
Clay	166	
Texture	Silt loam	

Table 2: The effect of phosphorus and tryptophan acid and their overlap on the rate of plant height (cm).

Phosphours Level ($kg.h^{-1}$)	Tryptophan concentrations ($mg.L^{-1}$)			Level of phosphours effect
	0	5	10	
0	102.8	109.2	108.2	106.7
30	113.6	114.5	116.6	114.9
60	109.9	112.7	115.3	112.6
Mean of Tryptophan effect	108.7	112.1	113.4	-
L.S.D. (0.05)	Phosphorus level = 1.1			
	Concentrations of tryptophan acid = 1.1			
	Overlap = 1.9			

green growth stage by using SPAD device, by taking three readings for several leaves for each experimental unit and then the rate was calculated.

• Estimating the Ratio of Dissolved Carbohydrate in the Green Part (%)

Preparing the Standard Curve: The stock solution was prepared from each of the glucose and fructose by solving 50mg from each of the glucose and fructose in one liter of distilled water, afterwards the concentrations (0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2 and 1.4)$mg.L^{-1}$ were prepared.

1ml of these concentrations and 1ml of phenol reagent 5% was added and they were mixed well, then 5ml of concentrated sulfuric acid H_2SO_4, then the color intensity resulted from measuring the photo-density by the spectrophotometer at the wavelength (488) nanometer, then the standard curve was drawn from the relation between the concentration and the reading of the photo-density.

Estimating the Ratio of Carbohydrate in the Leaves: To estimate the ratio of dissolved carbohydrate in the dry leaves of the green part, the method of (Herbert *et al.*, 1971), known as the method of (phenol sulfuric acid) was relied on, as a particular part from the dry plant sample was weighed and 50ml of boiled distilled water was added to it, then it was dried in a water bath at 80°C for 15 minutes, afterwards the sample and the filtrate load was filtered to 50 ml by distilled water, then 1ml of filtrate was taken and 5ml of H_2SO_4 was added to it. Also, 1ml of the phenol reagent 5% was added to it and they were mixed well and 10m of distilled water was added to it in order to dilute, then it was left to cool, after that the dissolved carbohydrate was estimated by measuring the color intensity using the spectrophotometer at the wavelength 488 nanometer.

The Statistical Analysis

The statistical analysis was conducted according to the followed design and a comparison was done to the significant differences between the means by selecting the Least Significant Difference (LSD) at a possibility level of (0.05) and the program (SAS) was used in the statistical analysis of the data (SAS, 2004).

Results and Discussion

The Effect of Phosphorus and Spraying with Tryptophan on the Shape and Physiological Characteristics of the Coriander Plant (*Coriandrum sativum* L.):

The plant height (cm):

The results of table 2, showed the presence of a significant effect at a possibility of 0.05 when adding levels of phosphorus fertilizer and spraying the tryptophan acid on the plant height as well as the presence of a significant effect at overlap.

The results of table 2, also indicated the presence of a significant difference between the phosphorus levels, as the fertilized plants at the level of 30$kg.h^{-1}$ gave the highest mean of the plant height mounting 114.9cm with an increase ratio of 7.68% and they differed significantly from other levels which gave the lowest mean in the length compared to the standard treatment for this characteristic mounting 106.7cm.

The increase occurring in the plant height is caused by the positive phosphorus role in the green growth strength in the bioprocesses, as it helps in dividing the cells and participating with them in forming the compounds rich with energy such as ATP, UTP, CTP and GTP necessary in forming the phospholipids and the enzyme attendants and $NADpH^+$ which accompany the representation of carbohydrate leading to the activation of the green growth and the increase of the plant height (Al-Ni'aimi, 1999).

These results agree with (Awwad, 1987), as he points out that the green part gave a higher response than the root aggregate and he explains that by the continuous

Table 3: The effect of phosphorus and tryptophan acid and their overlap on the rate of dry weight of coriander plant (gm).

Phosphours Level ($kg.h^{-1}$)	Tryptophan concentrations ($mg.L^{-1}$)			Mean phosphours effect
	0	5	10	
0	37.3	48.2	44.3	43.3
30	47.2	53.1	50.4	50.2
60	51.3	55.8	52.7	53.2
Mean of Tryptophan effect	45.3	52.4	49.1	-
L.S.D. (0.05)	Phosphorus level = 1.7			
	Concentrations of tryptophan acid = 1.7			
	Overlap = 21.9			

consumption of carbohydrate in the summit when the plant absorbs the phosphorus.

They also agree with Abbas *et al*., (2009) when they observed an increase in the height of the plant (*Matericari chamomilla* L.) when using the phosphorus fertilizer.

The results of the table also showed the presence of a significant effect as the concentration 10 mg.L^{-1} gave the highest mean of plant height mounting 113.4cm with an increase ratio of 4.32%, while the comparison treatment gave 108.7cm and the cause of plant height when sprayed by tryptophan is due to its being responsible of the vital construction of IAA, as in the plant there are four vital paths to make it and three paths depending on the amino acid tryptophan: Tryptophan-dependent Auxin Biosynthesis.

This multiplicity in the paths of the IAA from the tryptophan acid has an important role in the plant growth and development (Kobayashi, 1990, Mano, Nemoto, 2012) and this agrees with table 2, as it was found that the spraying of the amino acid tryptophan resulted in a significant increase in the summits of the branches from IAA and agrees with the findings of Talaat *et al*., (2005), as they found that the spraying of the tryptophan acid on the plant of *Pelargonium graveolens* resulted in an increase in the plant height.

The overlap between the phosphorus and tryptophan gave a significant effect, as the combination 30kg.h^{-1} and its concentration 10mg.L^{-1} gave the highest mean of the plant height mounting 116.6cm compared to the control treatment which gave the lowest mean of the plant height mounting 102.8cm, as the increase was 13.4%.

The dry weight (gm):

The results of table 3, affirmed the existence of a significant effect at the possibility of 0.05 when adding phosphorus levels and spraying the tryptophan acid, as well as the existence of a significant effect at the overlap between the two factors in the plant dry weight.

The results showed the existence of significant differences between the phosphorus levels and the fertilized plants were superior at the level 60kg.h^{-1}, as they gave the highest mean of dry weight mounting 53.2 with a ratio of 22.86% compared to the standard treatment which gave the lowest mean of dry weight mounting 43.3gm. the cause of the increase in the plant dry weight was due to the role of the phosphorus which activate the carbon representation process within the light of forming the important compounds such as ATP and NADpH, then the increase in forming the carbohydrate and their accumulation leads to an increase in the plant dry weight (Morro *et al*., 1993). This also agrees with what Al-Rubai'i (2011) mentioned that the phosphorus fertilizer has a positive impact on the characteristic of the dry weight of the green aggregate of *Matericari chamomilla* L. plant.

The results of the same table also indicated the existence of a significant effect between the tryptophan concentrations, as it gave the highest mean of dry weight in the plants sprayed by the acid with a concentration of 5mg.L^{-1}, as it was 52.4gm with an increase of 15.67%. while the control treatment gave the lowest mean of dry weight mounting 45.3gm. the increase in the plant dry weight treated by the tryptophan was due to the increase in the development and growth process in the number of trunks and the plant height as well as the increase in the green growth and the wide roots which increase the plant absorption of nutritional elements, then the increase of the efficiency of the carbon representation process and the increase of accumulated materials made in the plant such as starch and sugars (Mohammed and Al-Younis, 1991).

The phosphorus and tryptophan had a significant effect, as the combination of 60kg.h^{-1} phosphorus and the concentration of 5mg.L^{-1} tryptophan gave the highest mean of dry weight in the plant mounting 55.8gm compared to the standard comparison treatment which gave the lowest mean of dry weight in the plant mounting 37.3gm with an increase ratio of 44.6%.

The number of the plant branches (branch.plant^{-1}):

The results of table 4, indicate the existence of a significant effect at the possibility of 0.05 in the number of the plant branches when adding the phosphorus and spraying the tryptophan, as well as the existence of a significant effect of the overlap between them in this characteristic.

The results of table 4, showed the superiority of the fertilized plants at the level of 60kg.h^{-1}, as they gave the

Table 4: The effect of phosphorus and tryptophan acid and their overlap on the rate of branches number of coriander plant (branch.plant^{-1}).

Phosphours Level (kg.h^{-1})	Tryptophan concentrations (mg.L^{-1})			Mean phosphours effect
	0	5	10	
0	9.21	12.55	11.55	11.10
30	12.28	13.83	13.13	13.08
60	13.37	14.53	13.72	13.87
Mean of Tryptophan effect	11.62	13.64	12.80	-
L.S.D. (0.05)	Phosphorus level = 0.42			
	Concentrations of tryptophan acid = 0.42			
	Overlap = 0.72			

Table 5: The effect of phosphorus and tryptophan acid and their overlap on the rate of chlorophyll content of coriander plant (microgram.cm^{-2}).

Phosphours Level ($kg.h^{-1}$)	Tryptophan concentrations ($mg.L^{-1}$)			Mean phosphours effect
	0	5	10	
0	26.91	34.26	31.55	30.91
30	33.55	37.50	35.62	35.56
60	36.25	39.57	37.18	37.67
Mean of Tryptophan effect	32.24	37.11	34.78	-
L.S.D. (0.05)	Phosphorus level = 1.04			
	Concentrations of tryptophan acid = 1.04			
	Overlap = 1.80			

highest mean in the number of plant branches mounting 13.87 branch.$plant^{-1}$ with an increase ratio 24.95% compared to the comparison treatment which gave the lowest mean in the number of plant branches mounting 11.10 branch.$plant^{-1}$ and these results agreed with Al-Halabi (2012), as his results indicated that adding the phosphorus fertilizer had a significant effect on the number of branches in the plant of *Nigella sativa* L. which resulted in the stimulation of the process of cell division for being present abundantly in the buds, leaves and the new grown cells (Al-Ni'aimi, 1999).

Each of Diederichsen and Hammer (1998) affirmed the increase of the branches number of coriander plant (*Coriandrun sativum* L.) with and increase of the levels of the phosphorus fertilizer.

The results of the same table also indicate the existence of a significant effect in the mean number of the plant branches when sprayed with the tryptophan acid, as the plants sprayed with a concentration of 5mg.L^{-1} were superior and gave the highest mean in the number of the plant branches mounting 13.64 branch.$plant^{-1}$ with an increase ratio of 17.38%, while the control plants gave the lowest mean in the number of branches mounting 11.62 branch.$plant^{-1}$. The increase cause was due to oxine which works on the activity of the enzyme cytokinin oxidase to make it organize the levels of cytokinin in many parts of the plant during the different development process (Carabelli *et al*., 2007) and this control is done through its organizing the activity of the enzyme cytokinin oxidase or the enzyme (IPT) Adenosine phosphate isopenteny ltrans ferase which made it able to control the summit supremacy and the opening of side buds, as the cytokinins works on the opposite of oxine in breaking the summit supremacy and also adding them to the side buds stimulates their activity and opening, as well as the role of tryptophan acid in the increase of oxine levels in the side buds, stimulating them to grow or it may work on decreasing the quantity of ABA, aiding the increase of side buds growth and this agrees with the findings of Liu *et al*., (2011) and the combination of 60kg.h^{-1} phosphorus and the concentration of 5mg.L^{-1} tryptophan gave the highest mean in the number of plant branches mounting 14.53 branch.$plant^{-1}$ compared to the comparison treatment which gave the lowest number in the plant branches mounting 9.21 branch.$plant^{-1}$ and the increase ratio was 57.76%.

The Effect of Phosphorus and Tryptophan Acid and Their Overlap on Some Physiological Characteristics

• The Chlorophyll Content (microgram.cm^2): The results of table 5, showed the existence of a significant effect at a possibility of 0.05 when adding phosphorus and spraying with tryptophan on the plant content of chlorophyll, as well as the existence of a significant effect between them in this characteristic.

The results of table 5, also indicate that the plants fertilized with phosphorus at the level 60kg.h^{-1} gave the highest mean of leaves content than the chlorophyll for the plant, as it mounted 37.67 microgram.cm^{-2} with an increase of 21.86% compared to the standard treatment which gave the lowest rate for this characteristic mounting 30.91 microgram.cm^{-2}.

The cause of increase was due to the increase of the leave area resulted from the increase of the cells division and consequently will lead to the increase of the photosynthesis process and the increase of the chlorophyll content in the leaves (Jain, 2008). These results agree with Al-Rubai'i (2011) and Al-Halabi (2012) who pointed that the use of NPK resulted in a significant increase of the chlorophyll content in the plants of *Matericari chamomilla* L. and *Nigella sativa* L., respectively.

It is noted from the results of the same table also the existence of a significant effect when spraying the plants with tryptophan, as the plants sprayed with a concentration of 5mg.L^{-1} were superior when they gave the highest mean of the leaves content of chlorophyll mounting 37.11 microgram.cm^{-2} with an increase of 15.10% compared to the control treatment which gave the lowest mean for this characteristic mounting 32.24 microgram.cm^{-2}.

The cause of increase may be due to the oxine role in the increase of chlorophyll content (Osborne and Halloway, 1964, Antanaviciene, 1967, Ayalasilla *et al*., 2005). And this stimulates the growth organizer IIA resulted from the spraying of tryptophan acid for the formation of new wide roots (Ross and Salisbury, 1991), so the absorption of nutritional elements increases including nitrogen, magnesium, iron and sulfur and these elements are necessary in the composition and formation

Table 6: The effect of phosphorus and tryptophan acid and their overlap on the rate of carbohydrate content in the root aggregate of coriander plant (mg.gm^{-1}).

Phosphours Level (kg.h^{-1})	Tryptophan concentrations (mg.L^{-1}) 0	5	10	Mean phosphours effect
0	13.93	15.97	16.39	15.43
30	16.62	17.70	18.50	17.60
60	18.01	18.92	18.65	18.53
Mean of Tryptophan effect	16.19	17.53	17.85	-
L.S.D. (0.05)	Phosphorus level = 0.49			
	Concentrations of tryptophan acid = 0.49			
	Overlap = 0.85			

Table 7: The effect of phosphorus and tryptophan acid and their overlap on the rate of carbohydrate content in the green aggregate of coriander plant (mg.gm^{-1}).

Phosphours Level (kg.h^{-1})	Tryptophan concentrations (mg.L^{-1}) 0	5	10	Mean phosphours effect
0	20.12	25.69	23.64	23.15
30	27.20	29.72	27.91	28.28
60	18.01	18.92	18.65	18.53
Mean of Tryptophan effect	24.16	27.85	26.09	-
L.S.D. (0.05)	Phosphorus level = 0.88			
	Concentrations of tryptophan acid = 0.88			
	Overlap = 1.53			

of the chlorophyll molecule (Mohammed and Al-Younis, 1991). The results agree with the findings of Talaat (2005), as the spraying the *Pelargonivm graveolens* with the tryptophan resulted in the increase of leaves content of chlorophyll a, b. As for the overlap, it had a significant effect between the phosphorus and the tryptophan acid, as the combination of 60kg.h^{-1} of phosphorus and the concentration of 5mg.L^{-1} of tryptophan acid gave the highest mean of the plant content of chlorophyll mounting 39.57 microgram.cm^{-2}, while the standard comparison treatment gave the lowest chlorophyll content in the plant leaves mounting 26.91 microgram.cm^{-2} and the increase ratio was 47.05%.

• The Carbohydrate Content in the Root (mg.gm^{-1}): The results of table 6, showed the existence of a significant effect at the possibility of 0.05 for the addition of phosphorus and tryptophan on the carbohydrate content in the plant root, as well as the existence of a significant effect at the overlap between the levels of both factors for this characteristics.

The results of table 6, also indicated the superiority of phosphorus at the level of 60kg.h^{-1}, as it gave the highest mean of carbohydrate concentration mounting 18.53mggm^{-1} with an increase of 20.09% compared to the standard treatment which gave the lowest level mounting 15.43mg.gm^{-1}.

The table also showed that the spraying with the amino acid tryptophan gave significant differences in the carbohydrate content in the plant root, as the concentration of 10mg.L^{-1}, which gave the highest mean mounting 17.85mg.gm^{-1}, was superior with an increase of 10.25% compared to the standard treatment which gave the lowest mean mounting 16.19mg.gm^{-1}.

As for the overlap between the phosphorus and the tryptophan, its effect was significant, as the combination 60kg.h^{-1} of phosphorus and the concentration of 5mg.L^{-1} of tryptophan gave the highest level of carbohydrate in the plant root mounting 18.92mg.gm^{-1} and the control plants gave the lowest value mounting 13.93mg.gm^{-1} and the increase ratio was 35.82%.

• The Carbohydrate Content in the Green Part (mg.gm^{-1}): The results of table 7, showed the existence of a significant effect at the possibility of 0.05 when adding phosphorus and spraying the tryptophan in the carbohydrate content of the plant, as well as the existence of a significant effect at the overlap between the levels of both factors for this characteristic.

The results of the table indicated that adding 60kg.h^{-1} of phosphorus gave the highest mean for this characteristic mounting 28.28mg.gm^{-1} of carbohydrate in the plant with an increase of 22.15% compared to the standard treatment which gave the lowest mean of the carbohydrate content in the plant mounting 23.15mg.gm^{-1}.

It was noted from the results of the same table that there was a significant effect when spraying the tryptophan on the plants and the plants sprayed with the concentration of 5mg.L^{-1} by giving the highest mean of the carbohydrate content in the plant mounting 27.85mg.gm^{-1} with an increase of 15.27% compared to the standard treatment which gave the lowest mean mounting 24.16mg.gm^{-1}.

As for the overlap, its effect was significant between the phosphorus levels and the tryptophan acid concentrations in the carbohydrate content in the plant, as the combination 60kg.h^{-1} and the concentration of 5mg.L^{-1} gave the highest mean of carbohydrate in the plant mounting 29.72mg.gm^{-1} and the standard treatment gave the lowest rate of carbohydrate content in the plant mounting 20.12mg.gm^{-1} and the increase ratio was 47.71%.

The tables 6 and 7, indicated the increase of the carbohydrate content in the plant with an increase of the phosphorus level and the cause was due to the phosphorus role in encouraging the growth, yield and the increase of nitrogen absorption and thus it leads to encourage the chlorophyll formation, then the carbohydrate increase in the leaves and the increase of the efficiency of photosynthesis, as (Al-Maghribi, 2004, Al-Abbasi, 2009) found an increase in the carbohydrate content in the clove plant when adding the phosphorus to the plants.

This result agrees with the result of Al-Halabi (2012) that the use of phosphorus fertilizer resulted in an increase in the carbohydrate content in the plant of *Nigella sativa* L.

The cause behind the carbohydrate content in the tables 6 and 7, as a result of spraying the tryptophan for being the starter to form the auxin IAA which had the direct role in the cellular divisions and the elongation which spraying on the plant will lead to an increase in making the protein and most compounds necessary to the growth including the carbohydrate (Singh, 2003).

Ameen *et al*., (2011) concluded that spraying the garlic and onion plants with tryptophan resulted in the accumulation of carbohydrates and proteins.

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