ISSN: 1343-4292
Volume 140, Issue 01, April, 2022

Study the effect of spraying of Vitamin B3 and the amino acid Glycine and their overlap on some growth indicators of *Apium graveolens* L.

Wael Shakir Hameed Al-Jboory[1], Ahmed Omeran Enaya AL-sharea[2]

Ministry of Education, Education of Baghdad Karkh second Iraq[1]
Ministry of Education, Education of Baghdad Rusafa third Iraq[2]

ABSTRACT— The experiment was conducted for the 2019-2020 growing season. This study aimed to study the effect of spraying of vitamin B3 and the amino acid glycine and their interference on some growth indicators of celery plant; it is included the using three concentrations of the vitamin (0.75,150) mg.L^{-1} and three concentrations of glycine (0,50,100) mg.L^{-1}. The experiment was designed according to Randomized Complete Blocks Design (R.C.B.D.) with three replicates for each treatment. The averages were compared using the least significant difference (LSD) at a probability level (0.05), and the following results were revealed. 1- Vitamin B3 at different concentrations resulted in a significant increase in all the studied features, as the concentration of 75 mg.L^{-1} of the vitamin effect on plant height and number of leaves, while the concentration 150 mg.L^{-1} effect on root length, nitrogen rate, Phosphorous rate, magnesium rate, iron content, leaf content of chlorophyll and protein content. 2- The results indicated that the effect of the amino acid glycine at different concentrations caused a significant increase in all plant growth indicators (plant height, root length, number of leaves, nitrogen rate, phosphorus rate, magnesium rate, iron rate, leaf content of chlorophyll and protein rate. 3- The effect of the overlap between the two study factors was significant in all the studied traits, as the combination between 75 mg.L^{-1} of vitamin and 50 mg.L^{-1} of glycine has greater effect on plant height and number of leaves, while the combination between 150 mg.L^{-1} of vitamin and 50 mg.L^{-1} of glycine in was with greater effect on root length, nitrogen rate, phosphorous rate, magnesium rate, iron rate, leaf content of chlorophyll, protein rate.

KEYWORDS: Vitamin B3, Glycine, growth indicators, *Apium graveolens* L.

1. INTRODUCTION

Celery plant (*Apium graveolens* L.) is one of the plants of the umbrella family, famiy: Apiaceae (Umbelliferae), which includes about 270 genera and 2700 species of plants belonging to this family. Celery plant is considered an annual or perennial herbaceous plant with a distinctive aromatic smell and is widely cultivated in temperate and cold regions [30]. This plant is one of the winter vegetable crops in addition to its cultivation throughout the year; it is considered an important crop in temperate regions of the world, especially Asia, Europe and North America. It is grown in Iraq mainly for its leaves, which are rich in important mineral nutrients and antioxidants as well as for high medicinal value [28].

The medical importance of celery is due the presence of many effective medicinal compounds in its volatile oil, and the most important of these compounds is Limonen by 60% and Selinene by 10%, in addition to other compounds and these compounds are given the plant the a distinctive aromatic smell. Additionally, it contains organic acids including Malic acid and Citric acid, as well as amino acids [31]. Interestingly, celery plant contains many important and necessary substances such as vitamins (B1, B6, C, K, A), proteins and carbohydrates, and it also contains many important mineral elements, including iron, iodine, phosphorous, potassium and other elements [3]. The presence of these substances in the plant has made it of great medical importance, as it is used in many treatments, including the treatment of rheumatism, impotence and gout disease, and its seeds are also used in treating cases of dizziness and as a stimulant for menstrual flow [32].

For the reason of its original home in the temperate regions of Asia and its move to Europe on the coasts of the Mediterranean Sea, the Greeks knew it and called it (the lunar plant) and attributed it to it as nerves sedative and a treatment for teeth pain; the Arabs knew it since ancient ages, and Ibn Sina said about it: (Its seeds are used to prevent ascites and purify the liver, kidneys, bladder, uterus, and stimulate menstruation and urine). Moreover, Ibn al-Qayyim al-Jawziyyah said about it: (The moisturized leaves of the celery plant benefit the liver, generate urine and menstruation and break up the stones in the kidneys), while Ibn al-Bitar said: (The juice of the celery plant is useful for the treatment of fever, and its leaves benefit the stomach, liver, treat itching, scabies, and relieve eye and breast pain) [33].

The cultivation of the celery in the beginning was for its therapeutic effectiveness only; it was known in China 2000 years ago and its seeds were used in traditional Chinese medicine for treating dizziness and for reducing high blood pressure [29]. Furthermore, Pharaohs also used it in the treatment of parasites, bilharzia and intestinal worms, and also used it to stop eye congestion, break up of kidney stones, uterus inflammation and to reduce tumors [34].

Vitamins are known as organic compounds that are necessary for the growth and activity of the plant, and are essential in most of the metabolic processes that occur inside the plant, and are also important for metabolism processes balance, as the spraying of vitamins on the plant leads to growth stimulation via activating some enzymatic reactions through entering vitamins as biological cofactors and enzymatic adjuvants in many different biological processes [35], [13].

One of these vitamins is vitamin B3, nicotine amide. For the purpose of avoiding confusion between nicotinic acid (vitamin B3) and tobacco nicotine, this vitamin was called Niacin [35]. Moreover, it has an important role in many biological processes of plants due to its role into the biosynthesis of the enzymatic conjugates (NAD, NADP) [18], [35] as they work with a large number of dehydrogenases that are found in the cytoplasm and are necessary in the metabolism of basic biological compounds such as lipids, proteins and carbohydrates [15].

[1] study found that the spraying of vitamins on the plant is of great importance in stimulating the growth of a plant, and it is known that nicotine amide is a growth-regulating agent that affects many physiological processes such as the biosynthesis of enzymes, nucleic acids and proteins. In addition, nicotine amide acts as a coenzyme [8]. Whereas, the stimulating effects of nicotine amide (vitamin B3) on plant growth were found to be associated with an increase in the levels of internal plant activity, particularly gibberellin acid (GA3) and IAA, which have a role in stimulating the growth of plant organs [25].

Glycine is one of the simplest amino acids; it is an organic chemical compound with molecular formula is (CH_2CH_2COOH) and has a molecular weight of 75.07 $g.mol^{-1}$ and its chemical name is 2-amino ethanoic acid, which is the smallest amino acid among the amino acids that make up proteins. Glycine has physiological importance in plants, as it activates the photosynthesis process [19]. This acid also contributes to the synthesis of Glutathione, which is an antioxidant resulting from exposure to environmental stresses [21]. Interestingly, glycine also act to increase the plant tolerance to pollutant stress [22] it also works to stimulate the biosynthesis of chlorophyll [10] and has a role in the process of pollination and fruit production in plants [4].

2. Materials and Methods

The experiment was carried out during 2019-2020 season, and the plants were grown in sandins (pots). The experiment included studying the effect of spraying of vitamin B3 and glycine and their combination in some growth factors of celery plant. This study aimed to resolve an important problem out of problems that most plants suffer from it including celery plant, which is a lack or a decrease in growth indicators, including slow growth and a decrease in the chemical characteristics represented by the important mineral elements in the plant. Vitamin B3 was sprayed in three concentrations at (0, 75, 150) mg.L^{-1}, while the acid was sprayed at (0, 50, 100) mg.L^{-1} of concentration.

2.1 The experiment design

The experiment was designed according to the design of randomized complete block design (RCBD). The parameters in the experiment 3*3 will be distributed in three replicates as one replicator included 9 experimental units, thus the total number of experimental units becomes 27 experimental units (number of pots) and the capacity of each pot is 5 kg/soil. A soil sample was taken before cultivating for physical and chemical analysis, as shown in Table (1).

Table (1): The physical and chemical properties of the experiment soil before cultivating.

Elements		**Value**	**Unit**
Soil texture		**Soil mixture**	
Soil separators	**Sand**	345	gm.Kg^{-1} soil
	Silt	430	
	Clay	220	
pH		7.2	-----
EC		3.10	Decisemans.m^{-1}
Nitrogen		40.17	mg.Kg^{-1} soil
Phosphorous		12.90	mg.Kg^{-1} soil
Potassium		203	mg.Kg^{-1} soil

The neutral compound fertilizer NPK 20 = 20 = 20 was added to all the experimental units before cultivating at a rate of 0.50 g/pot, then the seeds were cultivated on 16/9/2019 by three trenches and in each pot and trench nine seeds were placed according to the experimental parameters, then they were reduced to six seeds after Two weeks of cultivating, and all crop servicing operations were conducted, including irrigation, hoeing and weeding whenever needed until the end of the experiment.

The plants were sprayed with the above concentrations; it was sprayed with the mentioned concentrations of vitamin B3, whiles the control group was sprayed with distilled water only in the early morning on 9/12/2019. It was sprayed on the leaves of the plants when they became 3-4 leaves after 83 days of cultivating date using hand sprinkler with a volume of (2) liters. Additionally, on 14/12/2019 in the early morning, the plants were sprayed with the above mentioned concentrations of glycine while the control group was sprayed with distilled water only. When the leaves became 3-4 leaves after 88 days of cultivating time using hand sprinkler with a volume of (2) liter. The samples were collected shoot system of celery at the rate of three plants from each experimental unit in order to study some of the growth factors and the chemical properties of the plant as follows:

1- Plant height (cm)
The plant height was measured of three plants from each experimental unit using a ruler.
2- Root length (cm)
The root length was measured of three plants collected randomly from each experimental unit from its connection point with stem to the end of main root using a ruler.
3- Leaves number (plant^{-1})
The number of leaves was calculated for three plants collected randomly from each experimental unit and then the average number was calculated.
4- Estimation of Nitrogen percentage (%) in the root and shoot system
The ground dried samples were digested according to [7] method. The percentage of nitrogen in the root and shoot system of celery was estimated using Kjeldahl method [11]. The percentage of nitrogen was calculated using following equation:

$$\mathbf{N\%} = \frac{\text{Volume of consumed x acid normality x 14 x dilution factor}}{\text{Volume of sample taken upon distillation x weight of digested sample x 1000}} \text{x100}$$

5- Estimation of phosphorus percentage (%) in the root and system
Phosphorous percentage was estimated using the ammonium molybdate method according to [16] method and using UV-Visible Spectrophotometer AT 420 nm.
6- Estimation of magnesium percentage (%) in the root and shoot system
Magnesium percentage was estimated using atomic absorption spectrophotometer and according to [26] method.
7- Estimation of iron percentage (%) in the root and shoot system
Iron percentage was determined using an Atomic absorption spectrophotometer and according to [2] method.
8- Estimation total chlorophyll in the leaves (mg.g^{-1})
The total chlorophyll content was determined according to the [6] method.
9- Estimation of protein percentage (%) in the root and shoot system
The percentage of protein in was estimated by multiplying the percentage of nitrogen by a constant factor (6.25) according to [24] method.

Protein (%) = N% x 6.25

3. Results and Discussion

3.1 The plant height

As shown in (Table 2), The results showed that there is a significant effect of vitamin B3 spraying treatments on celery plant height. The height average was revealed with Vitamin B3 spraying treatment at 75 mg.L^{-1} of concentration achieved; it was 20.59 cm compared to the control treatment (spraying with distilled water only) which was 16.94 cm. The reason for celery plant height after vitamin B3 spraying is may due to the role of vitamin B3 in improving of growth characteristics, including plant height through its participation into the formation of indole acetaldehyde, which is an intermediate compound of Auxin generator (IAA) that important in elongating and increasing number of plant cells. Furthermore, it is also considered as enzymatic cofactor in the metabolism process to release the energy required for many important and vital processes inside plant cells, which causes an increase and improvement in plant growth, including plant height [36], [17].

Additionally, the reason may be attributed to the fact that nitrogen is one of vitamin B3 components, which is importance in the biosysnthesis of proteins and nucleic acids that are included in the composition of the organic bases Pyrimidines and Purines, which in turn are involved in the synthesis of growth hormones such as cytokinin that has a role in encouraging the growth of vegetative buds [5] as well as increasing the production of amino acids, including tryptophane, a major source of some hormones including auxin that play an important role in hormonal balance and thus increases the size of the shoots, including plant height [14]. Interestingly, the vitamin spraying on plants has a great importance in stimulating the growth of a plant, especially plant height; it is known that nicotine amide (vitamin B3) is a growth-regulating agent that affects many physiological processes such as the biosynthesis of enzymes [8].

The results of this study (Table 2) also found that Glycine spraying on the celery had a significant effect on celery height average, so the treatment with 100 $mg.L^{-1}$ of glycine increased the celery height and the mean was 20.41 cm compared to the control treatment (spraying plants with distilled water only) where the mean was 16.64 cm. The reason for this may be due to the important amino acid role in increasing the activity of the shoot system (plant height) as it is a good source of nitrogen that stimulates proteins biosynthesis and auxins production and synthesis the nucleic acids RNA and DNA [23] by increasing the production of essential amino acids such as tryptophan, which is the initiator of IAA synthesis and also is important in promoting cell elongation [27].

Moreover, It may also be due to the role of this acid in chlorophyll biosynthesis as an osmotic regulator of guard cells, and this will effect on the opening of stomata [19], which leads to an increase in the efficiency of the photosynthesis process and uses of its products in the processes of growth and formation of cells, as well as glycine is an important nitrogen source in proteins and enzymes production which are necessary in cells formation and thus increase the vegetative growth of the plant, especially plant height [17].

The effect of the overlap between the studied factors was significant on the plant height average (Table 2). The treatment of Celery with vitamin B3 (75 $mg.L^{-1}$) and glycine (50 $mg.L^{-1}$) increased the plant height to 22.27 cm without significant difference from Plants sprayed with vitamin B3 at concentration of 75 $mg.L^{-1}$ and 100 $mg.L^{-1}$ of glycine where the mean was 21.33 cm, while the height was 14.10 cm in control group.

Table (2): The effect of vitamin B3 and glycine spraying and their overlap on celery plant height (cm)

Vit. B3 concentration ($mg.L^{-1}$)	**Glycine concentration ($mg.L^{-1}$)**			**Mean**
	0	**50**	**100**	
0	14.10	17.77	18.97	16.94
75	18.17	**22.27**	21.33	**20.59**
150	17.67	18.67	20.93	19.09
LSD (0.05)	1.39			0.81
Mean	16.64	19.57	**20.41**	
LSD (0.05)	0.81			

3.2 Root length

The results revealed there was a significant effect of vitamin B3 spraying on celery root length, as the spraying 150 mg.L^{-1} of vitamin B3 increased the root length and the average was 9.51 cm compared to the control group (spraying plants with distilled water only) and the average was 7.39 cm (Table 3). The reason for the greater effect of vitamin B3 in root length is may be attributed to its role in improving of growth characteristics via its participation in the formation of indole acetaldehyde, which is an intermediate compound of auxin generator (IAA) that important in elongating of plant cells and increasing their number, especially root cells [36], [17]. As the vitamin is of great importance in stimulating the growth of a plant, especially the growth of the root system.

Additionally, as shown in (Table 3), the results found that the spraying celery plant with glycine at 100 mg.L^{-1} of concentration caused a significant effect on the average of root length; the average was 9.60 cm compared to the control treatment (spraying plants with distilled water only) which the average was 7.21 cm. The reason for the effect of glycine on root length is may be due to the role of this amino acid in the growth and formation of plant cells, especially root cells. Glycine has an important role in many vital activities in the plant, and glycine is easily absorbed by the plant due to its low molecular weight.

The effect of the overlap between the two studied factors was significant on the average of celery root length plant root length (Table 3), as the plants that were sprayed with a concentration of 150 mg.L^{-1} of vitamin B3 and 50 mg.L^{-1} of glycine achieved the highest value of root length which was 10.65 cm, although there is no significant difference was found in comparison to those sprayed with a concentration of 75 mg.L^{-1} of vitamin B3 and 100 mg.L^{-1} of glycine which was 10.45 cm, while the average in control group was 5.35 cm.

Table (3): The effect of vitamin B3 and glycine spraying and their overlap on celery root length (cm)

Vit. B3 concentration (mg.L^{-1})	**Glycine concentration (mg.L^{-1})**			**Mean**
	0	**50**	**100**	
0	5.35	8.06	8.77	7.39
75	8.00	8.59	10.45	9.01
150	8.29	**10.65**	9.59	**9.51**
LSD (0.05)	0.83			0.48
Mean	7.21	9.10	**9.60**	
LSD (0.05)	0.48			

3.3 Leaves number (leaf.plant^{-1})

The results in (Table 4) found that there is a significant effect in number of leaves of celery plant after spraying with vitamin B3 at 75 mg.L^{-1}; the average was 10.39 leaf.plant^{-1} in comparison to average of control group (spraying plants with distilled water only) which was 8.32 leaf.plant^{-1}. The reason for the effect of vitamin B3 on leaves number is may be due to the role of vitamin B3 in improving growth characteristics, including leaves number through its participation in the formation of indole acetaldehyde, an intermediate compound of auxin generator (IAA); IAA is important in the elongation of plant cells and increase their number as well as considered as enzymatic cofactor in the metabolism process to release the energy needed for many important and vital processes inside plant cells, which causes an increase and improvement in plant growth, including an increase in leaves number [36], [17].

Furthermore, the reason is may also be attributed to the fact that vitamin B3 is one of its components, nitrogen, which is important in protein biosynthesis and nucleic acids that are included in the composition of the organic bases Pyrimidines and Purines, which in turn are involved in the synthesis of growth hormones such as cytokinin that has a role in encouraging the growth of vegetative buds [5]. As spraying the vitamin on plants is of great importance in stimulating the plant growth, especially increasing in leaves number. In addition, it is well known that nicotine amide (Vit. B3) is a growth-regulating agent that affects many physiological processes such as the biosynthesis of enzymes [8].

Interestingly, as shown in (Table 4), the results revealed the spraying celery plant with glycine at 100 $mg.L^{-1}$ of concentration caused a significant effect on the average number of celery leaves; the average was 10.50 $leaf.plant^{-1}$ as compared to control group (spraying plants with distilled water only) which the average was 8.16 $leaf.plant^{-1}$. The reason for the great effect of glycine is may be due to the role of this amino acid in chlorophyll biosynthesis as an osmotic regulator of guard cells and this in turn on stomata opening [19] and this cause an increasing in the efficiency of the photosynthesis process. Furthermore, photosynthesis products can utilized in the growth and formation of plant cells; amino acids, including glycine, also are an important nitrogen source in proteins and enzymes biosynthesis [17] that necessary in cells formation and thus increasing the vegetative growth of the plant, especially the number of leaves.

The effect of overlap between the two studied factors was significant on the leaves number average (Table 4), as the plants that were sprayed with a concentration of 75 $mg.L^{-1}$ of vitamin B3 and 50 $mg.L^{-1}$ of glycine achieved the highest value of combination which was 11.72 $leaf.plant^{-1}$; however no significant difference was found in comparison to those sprayed with a concentration of 75 $mg.L^{-1}$ of vitamin B3 and 100 $mg.L^{-1}$ of glycine which was 11.04 $leaf.plant^{-1}$. While the average in control group was 7.13 $leaf.plant^{-1}$.

Table (4): The effect of vitamin B3 and glycine spraying and their overlap on celery leaves number (leaf. $plant^{-1}$)

Vit. B3 concentration ($mg.L^{-1}$)	**Glycine concentration ($mg.L^{-1}$)**			**Mean**
	0	**50**	**100**	
0	7.13	11.8	9.72	8.32
75	8.31	**11.72**	11.04	**10.39**
150	9.06	9.57	10.74	9.79
LSD (0.05)	0.72			0.41
Mean	8.16	9.80	**10.50**	
LSD (0.05)	0.41			

3.4 Nitrogen percentage (%)

The results in (Table 5) showed that there is a significant effect of the treatment with vitamin B3 on the nitrogen percentage of celery plant. The spray with a concentration of 150 $mg.L^{-1}$ increased the nitrogen percentage which was 1.992% compared to the control treatment (Spraying plants with distilled water only) which the percentage was 1.549%. The reason for the significant effect of vitamin B3 with a concentration of 150 $mg.L^{-1}$ on nitrogen percentage is may be due to the fact that nitrogen is one of its components, [5] and this leads to an increase in the percentage of nitrogen in the plant.

In addition, the reason is may be due to the role of vitamin B3 in increasing nitrogen content in plants [9].

Moreover, the reason is may be due to the fact that spraying with vitamin B3 led to improved plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and extension, including root cells, and this leads to an increase in the growth of the root system, which led to an increase in the absorption of nutrients from the soil including nitrogen, and then increasing the nitrogen percentage in the plant compared to the control group.

The results also (Table 5) observed that the spraying with glycine had a significant effect on the nitrogen content average of celery plant, so the plants that 100 $mg.L^{-1}$ of concentration increased nitrogen percentage where it was1.945% compared to the control group (spraying plants with distilled water only) and the average was 1.586%.

The effect of the overlap between the two studied factors was significant on the average of nitrogen percentage (Table 5), as the plants that were sprayed with a concentration of 150 $mg.L^{-1}$ of vitamin B3 and 50 $mg.L^{-1}$ of glycine achieved the highest value nitrogen content to 2.194% without significant difference from Plants sprayed with a concentration of 75 $mg.L^{-1}$ and 100 $mg.L^{-1}$ of vitamin B3 and glycine respectively which was 2.152%, in comparison to control group and the average was 1.292%.

Table (5): The effect of vitamin B3 and glycine spraying and their overlap on celery nitrogen percentage (%)

Vit. B3 concentration ($mg.L^{-1}$)	Glycine concentration ($mg.L^{-1}$)			Mean
	0	50	100	
0	1.292	1.647	1.708	1.549
75	1.659	1.770	2.152	1.861
150	1.807	**2.194**	1.975	**1.992**
LSD (0.05)	0.172			0.099
Mean	1.586	1.870	**1.945**	
LSD (0.05)				

3.5 Phosphorous percentage (%)

As shown (Table 6), the results found that there is a significant effect on phosphorous percentage in celery plant after vitamin B3 spraying at 150 $mg.L^{-1}$ of concentration and the average was 0.411% compared to the control group (Spraying plants with distilled water only) which was 0.295%. The reason for this effect of vitamin B3 with a concentration of 150 $mg.L^{-1}$ in phosphorus percentage is may be due to improvement of plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and expansion, including root cells, and this leads to increase the growth of the root system, which led to an increase in the absorption of nutrients from the soil, including phosphorus, and then an increase in the phosphorus percentage in the plant compared to the control treatment.

Moreover, the results in (Table 6) found that the spraying with of celery with glycine at 100 $mg.L^{-1}$ had a significant effect on the average phosphorous percentage in celery plants; it was 0.396% compared to the control group (spraying plants with distilled water only) which the percentage was 0.322%. The reason for this effect is may be due to the fact that spraying with glycine has improved plant growth via its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and expansion, including root cells, and this leads to an increase in the growth of the root system, and increase in the absorption of nutrients from the soil including phosphorus which lead to augment phosphorus percentage in the plant compared to the control treatment.

The effect of the overlap between the two studied factors was significant on average of phosphorus (Table 6), as the plants sprayed with a concentration of 150 mg.L^{-1} of vitamin B3 and 50 mg a liter-1 of the amino acid clycin achieved the highest value of the interaction amounted to 0.451% without significant difference from Plants sprayed with a concentration of 75 and 100 mg.L^{-1} of vitamin B3 and glycine respectively, the average was 0.442%, while it was 0.248% in control group.

Table (6): The effect of vitamin B3 and glycine spraying and their overlap on celery phosphorous percentage (%)

Vit. B3 concentration (mg.L^{-1})	**Glycine concentration (mg.L^{-1})**			**Mean**
	0	**50**	**100**	
0	0.248	0.293	0.345	0.295
75	0.338	0.360	0.442	0.380
150	0.380	**0.451**	0.402	**0.411**
LSD (0.05)	0.036			0.021
Mean	0.322	0.368	**0.396**	
LSD (0.05)	0.021			

3.6 Magnesium percentage (%)

The results in (Table 7) found that there is a significant effect in magnesium percentage after spraying with vitamin B3 at concentration of 150 mg.L^{-1} and the average was 0.630% compared to the control group (Spraying plants with distilled water only) which was 0.489%. The reason for the significant effect of vitamin B3 at 150 mg.L^{-1} in magnesium percentage is may be attributed to its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and expansion, including root cells, and this leads To increase the growth of the root system, which led to an increase in the absorption of nutrients from the soil, including magnesium, and then an increase in magnesium percentage in the plant compared to the control treatment.

In addition, the results also showed in (Table 7) that the treatment of spraying with glycine at 100 mg.L^{-1} of concentration had a significant effect on magnesium percentage average in celery plants; the average was 0.606% compared to the control group (spraying plants with distilled water only) which the average was 0.514%. The reason for this effect is may be due to the fact that spraying with glycine led to improved plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and extension, including root cells, and this leads to increased growth of the root system, which led to an increase in the absorption of nutrients from the soil, including magnesium, and then an increase in the magnesium percentage in the plant compared to the control treatment.

The effect of the overlap between the two studied factors was significant on magnesium percentage (Table 7), as the plants that were sprayed with a concentration of 150 mg.L^{-1} of vitamin B3 and 50 mg.L^{-1} of glycine achieved the highest value of magnesium ratio to 0.682%, although there is no significant difference was found in comparison to those sprayed with a concentration of 75 mg.L^{-1} of vitamin B3 and 100 mg.L^{-1} of glycine which was 0.640%, while it was 0.424% in control group.

Table (7): The effect of vitamin B3 and glycine spraying and their overlap on celery magnesium percentage (%)

Vit. B3 concentration (mg.L^{-1})	**Glycine concentration (mg.L^{-1})**			**Mean**
	0	**50**	**100**	
0	0.424	0.482	0.562	0.489
75	0.526	0.578	0.640	0.582
150	0.592	**0.682**	0.615	**0.630**
LSD (0.05)	0.054			0.031
Mean	0.514	0.581	**0.606**	
LSD (0.05)				

3.7 Iron percentage (%)

As shown in (Table 8), the results revealed that there is a significant effect on Iron percentage in celery plant after spraying with vitamin B3 at 150 mg.L^{-1}; the average was 0.145% compared to control group (spraying plants with distilled water only) which the average was 0.119%. The reason for this effect is may be attributed to the fact that spraying with vitamin caused an improvement in plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and expansion, including root cells, and this leads to an increase in root system growth, which led to an increase in the absorption of nutrients from the soil including iron and then increased its content in the plant compared to the control treatment.

Moreover, the results also (Table 8) found that spraying celery plant with glycine at 100 mg.L^{-1} caused a significant effect on the iron average, and the average was 0.144% compared to the control group (spraying plants with distilled water only) which the average was 0.114%. The reason for this effect is may be due to the fact that spraying with glycine improved plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and extension, including root cells, and this leads to an increase in the root system growth, which led to an increase in the absorption of nutrients from the soil including iron and then increase the percentage of iron in the plant compared to the control treatment.

The effect of the overlap between the two studied factors was significant on the iron average iron (Table 8), as the plants sprayed with a concentration of 150 mg.L^{-1} of vitamin B3 and 50 mg.L^{-1} of glycine achieved the highest value of iron percentage with 0.163%, while the average in control group was 0.092%.

Table (8): The effect of vitamin B3 and glycine spraying and their overlap on celery iron percentage (%)

Vit. B3 concentration (mg.L^{-1})	**Glycine concentration (mg.L^{-1})**			**Mean**
	0	**50**	**100**	
0	0.092	0.128	0.137	0.119
75	0.127	0.135	0.144	0.135

150	0.123	**0.163**	0.150	**0.145**
LSD (0.05)	0.011			0.006
Mean	0.114	0.142	**0.144**	
LSD (0.05)	0.006			

3.8 Chlorophyll content in leaves (mg.g^{-1})

The results in (Table 9) revealed that there is a significant effect of vitamin B3 spraying at concentration 150 mg.L^{-1} on the average of chlorophyll content in celery leaves; the average was 742 mg.g^{-1} in comparison to the average of control group (spraying plants with distilled water only) which was 547 mg.g^{-1}. The reason for this effect on chlorophyll content is may be due to the fact that spraying with vitamin B3 led to the improvement of plant growth via its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and expansion, including root cells, and this leads to an increase in the root system growth, which led to an increase in the absorption of nutrients from the soil including nitrogen, magnesium and iron, resulting in an increase in the chlorophyll content of leaves by increasing the elements of great importance in the composition of chlorophyll, including nitrogen (Table 5), magnesium (Table 7) and iron (Table 8), whereas, nitrogen is one of Pyroferin ring component, which is one of the important compounds in formation of chlorophyll molecule [12]. In addition, it is may also be attributed to the fact that vitamin B3 is one of its components, nitrogen, which is of great importance in the synthesis and formation of the chlorophyll molecule.

The results as shown in (Table 9) found that the spraying with glycine at 100 mg.L^{-1} had a significant effect on chlorophyll content average of the leaves in celery plant; the average was 705 mg.g^{-1} compared to the control group (spraying plants with distilled water only) which was 575 mg.g^{-1}. The reason for this is may be attributed to the role of the amino acid that activates chlorophyll formation [10]. Furthermore, it may also be due to the fact that amino acid is a good source of nitrogen, which is an important element in formation of the chlorophyll molecule. It may also be due to the role of this acid in chlorophyll formation as an osmotic regulator of guard cells and effect on the stomata opening [19] this leads to an increase in the efficiency of the photosynthesis process and using of its products in the processes of formation and growth of the cells [17].

In addition, the reason for the great effect of glycine is may be due to the fact that spraying with this amino acid improved plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and extension, including root cells, and this leads to an increase in the growth of the root system, which led to an increase in absorption of nutrients from the soil, including nitrogen, magnesium and iron, and this led to an increase in the chlorophyll content of the leaves by increasing the elements that important in the composition of chlorophyll, including nitrogen (Table 5), magnesium (Table 7) and iron (Table 8).

The effect of the overlap between the studied factors was significant in the average of chlorophyll content in leaves (Table 9), as the plants that were sprayed with a concentration of 150 mg.L^{-1} of vitamin B3 and 50 mg.L^{-1} of glycine achieved the highest value of interaction with average by 815 mg.g^{-1} Without significant difference from the plants that were sprayed with a concentration of 75 mg.L^{-1} of vitamin B3 and 100 mg.L^{-1} of glycine and the average was 757 mg.g^{-1}, while the average in control group was 437 mg.g^{-1}.

Table (9): The effect of vitamin B3 and glycine spraying and their overlap on leaves chlorophyll content (mg.g^{-1})

Vit. B3 concentration ($mg.L^{-1}$)	Glycine concentration ($mg.L^{-1}$)			Mean
	0	50	100	
0	0.437	0.568	0.637	0.547
75	0.599	0.685	0.757	0.680
150	0.690	**0.815**	0.721	**0.742**
LSD (0.05)	0.074			0.043
Mean	0.575	689.0	**0.705**	
LSD (0.05)	0.043			

3.9 Protein percentage (%)

The results that shown in (Table 10) found that there is a significant effect of the protein content of the celery plant after spraying with vitamin B3 at concentration of 150 $mg.L^{-1}$; the average was 12.45% compared to the average of control group (spraying plants with distilled water only) which was of 9.68%. The reason for this effect on protein percentage is may be due to the fact that nitrogen is one of vitamin B3 composition [5] and this leads to an increase in the percentage of protein in the plant because nitrogen is one of the most important elements in biosynthesis of amino acids and thus leads to an increase in the percentage of protein in the plant. Moreover, it is may be attributed to the role of vitamin B3 in increasing nitrogen percentage in the plant [9], thus leading to an increase in the protein content in the plant. Furthermore, This is may be also due to its superiority in the chlorophyll content of leaves resulting in an increase in the efficiency of the photosynthesis process and thus leads to an increase in the formation of proteins and its content in the plant. The reason is may also to its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and extension, including root cells, and this leads to an increase in the growth of the root system, which led to an increase in the absorption of nutrients from the soil, including nitrogen and phosphorus (Table 5 and 6), which are considered the most important elements in amino acids biosynthesis, and this leads to an increase in the protein content of the plant.

Interestingly, the results in (Table 10) fond that the spraying celery with glycine at 100 $mg.L^{-1}$ of concentration caused a significant effect on protein content average; the average was 12.16% compared to the control group (spraying plants with distilled water only) which was 9.91%. The reason for this effect of glycine is may be due to the fact that glycine is an important nitrogen source in proteins biosynthesis [17] and this led to an increase in the protein content in the plant, as well as may be due to the fact that the spraying with amino acid led to improving plant growth through its role in increasing the activity of metabolic activities and vital processes within plant tissues such as cell division, elongation and expansion, including root cells, and this leads to an increase in the growth of root system causing an increase in the absorption of nutrients from the soil, including nitrogen and phosphorous (Table 5 and 6), which are considered among the most important elements in amino acids synthesis, resulting in an increase in the percentage of protein content in the plant.

The effect of the overlap between the two studied factors was significant on the protein percentage (Table 10), as the plants sprayed with a concentration of 150 $mg.L^{-1}$ of vitamin B3 and 50 $mg.L^{-1}$ of glycine achieved the highest value which was 13.71%, however there is no significant difference from plants sprayed with a concentration of 75 $mg.L^{-1}$ of vitamin B3 and 100 $mg.L^{-1}$ of glycine 13.45%, while the average in control treatment was the lowest average by 8.07%.

Table (10): The effect of vitamin B3 and glycine spraying and their overlap in protein percentage (%).

Vit. B3 concentration (mg.L^{-1})	Glycine concentration (mg.L^{-1})			Mean
	0	50	100	
0	8.07	10.29	10.68	9.68
75	10.37	11.06	13.45	11.63
150	11.29	**13.71**	12.34	**12.45**
LSD (0.05)	1.07			0.62
Mean	9.91	11.69	**12.16**	
LSD (0.05)	0.62			

4. References

[1] Aberg, B.1961. Vitamins as growth factors in higher plants. Encyclopedia of Plant Physiology, 14:418 – 448.

[2] Allan, J.E. (1961). The determination of zinc in agricultural material by atomic absorption spectrophotometer. Analyst, Lond., 530 – 534.

[3] Belal, N.M. (2011). Hepatoprotective effect of feeding celery leaves mixed with chicory leaves and barley grains to hyper cholesterol emic rats. Asian J. Clin. Nutr., 10: 32-43.

[4] Bhunia, D. and Mondal, A. K. (2012). Studies on production, morphology and free amino acids of pollen of four members in the genus Nymphaea L. (Nymphaeaceae). International Journal of Science and Nature, 3(3) :705-718. Biol. Plantarum, 45:481-487.

[5] Edeson , C.E. ;G.S. Howell and A.J. Flore . 1995. Influence of crop load on photosynthesis and dry matter partitioning of seyval grope vines .II seasonal changes in single leaf and whole vine photosynthesis . Amer. J. Enol. Vitic., 46(4):469-477.

[6] Goodwin, T. W. (1976). Chemistry and Biochemistry of Plant Pigment. 2nd ed. Academic. Press. London, New York. San Francisco: 373.

[7] Gresser, M. S. and Parson, J. W. (1979). Sulphuric, perechloric and digestion of plant material for magnesium. Analyt. Chem. Acta, 109: 431-436

[8] Hathout, T.A., 1995. Diverse effects of uniconazole and nicotin amide on germination, growth, endogenous hormones and some enzymic activities of peas. Egyptian J. of Physiol. Sciences, 19: 77-95.

[9] Hathout, T.A., S.A. Shetawi and S.M. Khallal, 1993. Mode of application of some growth regulators on physiology of tomato . III, Effect of Nicotineamide on morphology, growth, metabolism and productivity. Egypt. J. Physiol. Sci., 17(2): 183-200.

[10] Hendry, G.A.F. and Stobart, A.K. (1977). Glycine metabolism and chlorophyll synthesis in barley leaves. Phytochemistry, 16(10): 1567-1570.

[11] Jackson, M. L. (1958). Soil Chemical analysis prentice. Hall Inc. Englewood, Cliffs, N. T., USA.

[12] Karron, M. G., and Maranvilla, J. H. (1994). Response of wheat cultivars to different soil nitrogen and moisture regime . I. Dry matter partitioning and root growth . J. Of Plant Nutri. 17: 729-744P.

[13] Kefelie, V.I. 1981 . Vitamins and some other representatives of non- hormonal plant growth regulators. Priki Biokhim. Micrbiot.,17:5 -15.

[14] Laffite, H. R. and R. S. Loomis. 1988. Growth and composition of grain sorghum with limited nitrogen. Agro. J.,80:492-498.

[15] Noctor, G. ; G. Queval and B. Gakiere .2006. NAD(P) synthesis and pyridine nucleotide cycling in plants and their potential importance in stress conditions. J. Exp. Bot.,58:1603–1620.

[16] Olsen, S. K. and Sommers, L. E. (1982). Phosphorus In: Page, A. L.et al. (eds.) Mcthods of soil analysis. Amer. Agron. Inc., Madison, Wisconsin, New York.

[17] Rai, V. K. 2002. Role of amino acids in plant responses to stresses.

[18] Robinson, F.A.1973. Vitamins in Phytochemistry, Vol. III :In : Lawrence P. Miller (Ed.).195 – 220. Van-Nostrand Reinhold Co., New York. USA.

[19] Sharaf, A.E.M.; Farghal, I.I. and Sofy, M.R. (2009). Response of broad bean and lupin plants to foliar treatment with boron and zinc. Australian Journal of Basic and Applied Sciences, 3(3): 2226-2231.

[20] Singh, B. K. 1999. Plant amino Acids: Biochemistry and biotechnology. Marcel Dekker Inc., New York, USA.

[21] Soni, G.L.; George, M. and Singh, R. (1982). Role of common Indian pulses as hypocholesterolaemic agents. Indian Journal of Nutrition and Dietetics, 19:184-190.

[22] Sun, H.; Liu, H.; Cui, J.; Liu, X.; Yang, L. and Xu, J. (2010). Effect of exogenous Gly on the growth and oxidative damage of alfalfa seedling under Cd stress. Chinese Journal of Eco-Agriculture,18(5): 1022-1025.

[23] Thomas , J. ; A. Mandal ; R. Raj Kumar and A. Chordia .2009 . Role of biologically active amino acid formulations on quality and crop productivity of Tea (Camellia sp.). Int. J. Agr. Res.,4: 228-236.

[24] Vopyan, V. G. (1984). Agricultural Chemistry English Translation. Mir. Publisher. 1st. End.

[25] Wilkins, M.B., 1989."Advanced plant physiology". Pitman Publishing Inc. London.

[26] Wimberly, N. W. (1968). The Analysis of Agriculture Material. MAFF. Tech. Bull. London.

[27] Wona , C. ; X. Shena ; K. Mashiguchib ; Z. Zhengc ; X. Daia ; Y. Chenga ; H. Kasaharab; Y. Kamiyab ; J. Choryc and Y. Zhaoa .2011. Conversion of tryptophan to indole-3-acetic acid by tryptophan aminotransferases of Arabidopsis and yuccas in Arabidopsis. PNAS,108 (45): 18518–18523.

[28] Yaser, A.; Muneer, A.; Abdelhafid, B. and Fawzia, A. (2014). Chemical composition, phytochemical constituents and antioxidant activities of the leaves extract of celery from Yemen. Res. J. Pharma. Biol. Chem. Sci., 5(1): 1074-1087.

[29] Zhang, P.Z. (2006) Explanation of the Name of the Chinese Vegetable. Beijing Yanshan Press. Beijing. China.

[30] El-aroussi, Hussein and Menoufi, Osama Abdel-Hameed (2004), The General Plant, Modern Knowledge Library, Alexandria, Egypt.

[31] Syed, Abdul Basit Muhammad and Hussein, Abd al-Tawab Abdullah (2004) The Mother Encyclopedia of Medicinal Herbal and Plants. Alpha Publishing and Distribution Dar, Cairo, Egypt.

[32] Rouihah, Amin (1983) Herbal treatments. Seventh edition, Dar Al-Qalam, Beirut, Lebanon.

[33] Qudamah, Ahmad (1982) Food Dictionary and medical treatments plants. Second edition, Dar Al-Nafaes, Beirut, Lebanon.

[34] Abdel-Al, Adel (2007) Ancient Medicine. Third edition, Ajyal Publishing and Distribution Dar, Egypt.

[35] Al-Ghubashi, Refaat Al-Sayed. (2005) Chemistry - and biology of vitamins. Scientific Books House for Publishing and Distribution, Cairo The Egyptian Arabic Republic.

[36] Devlin, Robert. Witham, M. and Francis. 1993 - Plant Physiology. Translated by Shawqi Muhammad Mahmoud, Abd al-Hadi Khader, Ali Saad al-Din Salama, Nadia Kamel and Muhammad Fawzi Abdul Hameed. Arab Publishing and Distribution Dar, Cairo. Egypt.