Efficacy of Foliar Application of Tryptophan, Gibberellic Acid and Add Organic Liquid Fertilizer on Vegetative Growth, Yield Improvement, and Quality of Apricot Trees cv. "Zaghinia"

Ahmed Ali Khalaf Al-Dulaimi and Atheer Mohammed Ismail Al-Janabi

Department of Horticulture and Landscape Gardening, College of Agriculture, University of Anbar, Ramadi, Iraq.

Corresponding author's email : **E-mail:** ahm22g5001@uoanbar.edu.iq
E-mail: ag.atheer.mohammed@uoanbar.edu.iq

ABSTRACT

To investigate the effect of foliar application of tryptophan and gibberellic acid, along with the addition of liquid organic fertilizer, on some vegetative and fruiting characteristics and their chemical composition of apricot trees (*Prunus armeniaca* L., cv. Zaghinia), an experiment was carried out in a private orchard located in Al-Anbar Governorate, Iraq, during the 2023–2024 growing season. The study included 54 trees, nine years old and as homogeneous as possible in their growth. A completely randomized block design was used, as (3 x 3 x 2) factorial experiment arranged in three replicates, each consisting of 18 trees, with each tree representing one experimental unit. Tryptophan was sprayed at three concentrations: 0, 100, and 200 mg L^{-1} symbolized as (T0, T1, and T2), respectively. Gibberellic acid (GA_3) three levels: 0, 50, and 100 mg L^{-1} designated as (G0, G1, and G2). Liquid organic fertilizer was applied to the soil at two levels: 0 and 150 mL L^{-1} signified as (O0 and O1) The results indicated that the triple interaction treatment (T2 × G2 × O1) showed a significant superiority in increasing the mean shoot length and diameter, fruit set percentage, total yield per tree, fruit weight, and total soluble solids (TSS) percentage, in addition to reducing fruit drop and total acidity of the juice. The respective values recorded were 45.61 cm, 6.05 mm, 23.29 cm^2, 39.06 mg 100 g^{-1} fresh weight, 47.07%, 48.02%, 14.92 kg $tree^{-1}$, 25.92 g, 14.57%, and 0.98%, compared with the control treatment (T0 × G0 × O0), which showed the lowest values of 36.02 cm, 5.02 mm, 19.12 cm^2, 28.58 mg 100 g^{-1} fresh weight, 37.75%, 54.85%, 9.80 kg $tree^{-1}$, 12.51 g, 14.57%, and 1.24%, respectively.

Keywords | Apricot , Tryptophan , Gibberellic , Liquid organic fertilizer , vegetative , Yield , Fruit Drop.

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is a deciduous, stone-fruited plant belonging to the family Rosaceae. It was previously believed that Armenia was the original homeland of the apricot, as the Romans referred to it as the (Armenian apple) **[22]**. However, later studies revealed that the true origin of this fruit species is China and Central Asia, where it was found growing wild in natural forests across the Himalayan region. The term Apricot is thought to have originated from the Greek

ISSN 2072-3857

word Al-Praecox, meaning (early fruit) **[3].**

The world-wide production of apricots reached approximately 3,728,155 tons, cultivated on an estimated area of 554,359 hectares. Turkey classified as the foremost global country in apricot production with about 750,000 tons, followed by Iran in second place **[17]**. In Iraq, the total number of productive apricot trees reached approximately 1,064,432, with a total production of about 34,153 tons, averaging 32.09 kg per tree. Salah al-Din Governorate topped the list of national production levels, accounting for 48.37% of the country's total output **[14]**.

One of the earliest summer fruits to see market appearance, apricot fruit is notable for its high nutritional value and is rich in iron—an essential element for the formation of hemoglobin. It is another important source of vitamin A which is essential to body growth and development. Meanwhile, apricot fruit is known for its beneficial physiological properties: not only does it aid in moisturizing and cooling the stomach, it helps to dissolve kidney stones and get rid of intestinal worms. Chemically speaking, each 100 g of fresh apricot pulp contains about 86.35 g water, providing about 53 kcal, in addition to 9.24 g of sugars, 2 g of dietary fiber, 1.40 g of proteins, and 0.39 g of fats **([31]; [11]).**

Despite favourable environmental and climatic conditions in Iraq for apricot cultivation, this crop remains relatively limited and underdeveloped for several reasons, especially small cultivated areas and low average yield per tree. Apricot cultivars are mostly short-growing-season trees, and rarely develop alternate bearing, flowering once a year and yielding a fairly large quantity of flowers and fruits. Furthermore, various apricot cultivars are self-fertile, which increases the number of flowers and initial fruit set. However, this commonly leads to sharp drop in the fruit after setting, before harvest and at a diminished quality of the fruit, and diminutions in size **[11]**. These issues together pose significant difficulties for growers and producers, and stimulated a more intensive research work to solve these issues. One recent method used in this area is the application of amino acids in plant nutrition since they play a major role in enhancing plant growth and production. L-Tryptophan is recognized to be one of the most important amino acids because it is involved in controlling growth and developmental processes of a plant. Besides being a fundamental component of protein synthesis, it acts as a major biochemical precursor for auxin biosynthetic pathways, the key plant growth regulators responsible for cell elongation and division, all of which have a positive effect on the plant’s physiological performance and productivity **([27]; [37]).**

Besides, it was reported that amino acids, especially tryptophan, possess antioxidant properties that can improve plant tolerance to different environmental stresses such as drought, high temperatures, and salinity. A second implication is that they are contributing components to the plant defense system against pathogens by stimulating biochemical immune responses. Thus, tryptophan is one of the important regulatory molecules that serves in balancing the growth and productivity of plants **[2]**. Plant growth regulators are widely used in commercial fruit production to enhance growth and increase yield, particularly in deciduous fruit trees. Their efficacy is to enhance fruit set,

ISSN 2072-3857

diminish flower and fruit drop and to grow fruit larger and heavier **[28].**
Gibberellic acid (GA_3) is one of the most biologically active forms of gibberellins, and is widely used in fruit trees to enhance vegetative and reproductive growth, among these regulators. This compound plays a major role in the promotion of fruit quality through several physiological effects, such as encouraging cell elongation and expansion, improving photosynthetic efficiency and assisting plant pigment synthesis. Moreover, GA_3 improves the transport and exchange of mineral elements by increasing membrane permeability, thereby facilitating metabolic processes that stimulate the synthesis of nucleic acids and enhance protein production **([15]; [25]; [19])**. An effective method for boosting the growth of fruit trees is through soil application of liquid organic fertilizers, which are environmentally benign agricultural inputs. These fertilizers are readily available on the market at reasonable prices and improve the physical and chemical properties of the soil. They help increase the soil's water-holding capacity and strengthen plant tolerance to drought conditions **[29].**

The present study aims to evaluate the effects of the investigated factors and their interactions on vegetative growth characteristics, as well as to assess improvements in yield traits and chemical composition of apricot trees. In addition, the study seeks to identify the most effective treatment combination that can be adopted to overcome some or all of the previously mentioned problems.

MATERIALS AND METHODS

The study was conducted in private orchards located in the Zogair area, located at 18 km northwest of Ramadi city center, during the 2023–2024 growing season. The experiment included 54 uniform trees of the Zaghinia apricot cultivar, almost nine years old, grafted on seedling apricot rootstock. The trees were planted at a spacing of 4 × 4 meters, irrigated by the surface irrigation system, and trained according to the central leader system. All routine crop practices were done during the season such as weeding, removal of wild plants, and control of insect pests and fungal diseases. During the dormancy period, the organic fertilization was carried out, applying 10 kg of decomposed animal manure per tree, and chemical fertilization was applied of 100 g N, 50 g P, and 50 g K per tree **[33]**. The trees were pruned at the beginning of winter during the dormant bud stage by removing dead and broken branches and thinning out tangled branches to improve tree structure and enhance ventilation and light penetration within the canopy. Soil analysis of the orchard was performed before the experiment.

Table 1: Pysical and chemical properties of the tested ssoil

Particles size distribution (%)				Available nutrients (mg kg^{-1})					
Clay	**Sand**	**Silt**	**Texture**	**Ph**	**EC**	**O.M.**	**N**	**P**	**K**
25	**34**	**35**	**Sand loamy**	**7.8**	**1.8**	**1.25**	**47.8**	**4.7**	**104.6**

ISSN 2072-3857

The experiment included three main factors, as follows:

The first factor – Amino acid (L-Tryptophan):

T0: Control treatment (spraying with water only, without tryptophan solution).

T1: Spraying with tryptophan at a concentration of 100 mg L^{-1}.

T2: Spraying with tryptophan at a concentration of 200 mg L^{-1}.

The tryptophan used was of German origin, with an active ingredient concentration of 98.00%.

1. The second factor – Plant growth regulator (Gibberellic Acid, GA_3):

G0: Control treatment (spraying with water only, without GA_3 solution).

G1: Spraying with GA_3 at a concentration of 50 mg L^{-1}.

G2: Spraying with GA_3 at a concentration of 100 mg L^{-1}.

The GA_3 used was of German origin, with an active ingredient concentration of 98.00%.

2. The third factor – Soil application of liquid organic fertilizer (TARASOIL ORGANIC):

This factor was applied at two levels:

O0: Without the addition of liquid organic fertilizer (control).

O1: Soil application of liquid organic fertilizer at a concentration of 150 mL L^{-1}.

The fertilizer was applied according to the manufacturer's recommendations. Its composition included 54% organic matter, 5.5% humic acid, 31% fulvic acid, 2% total organic nitrogen, 2% K_2O, 31% total organic carbon, and a C/N ratio of 15.5. The product was of Indian origin.

Foliar spraying with both L-tryptophan and gibberellic acid (GA_3) was carried out three times. The first application was made at the full-bloom stage (when 60–80% of flowers were open), on 3rd and 10th of March, followed by two additional sprays at three-week intervals. Spraying was performed early in the morning until complete wetting of leaves and vegetative parts was achieved, using a wetting agent at a concentration of 0.01%. The soil application of liquid organic fertilizer, it was applied to the trees twice, on 2nd and 3rd October to ensure the suitable supply of essential nutrients needed to support vegetative growth and improve the chemical characteristics of the trees.

Experimental Design and Statistical Analysis

A Randomized Complete Block Design (RCBD) as (3 × 3 × 2) was done, following the procedure described by **[10].** The study included three replications, each consisting of 18 treatments, with one tree representing a single experimental unit. Accordingly, the total number of trees used in the study was 54.Data were collected and analyzed for both physical and chemical characteristics using the GenStat statistical analysis software. The obtained results were evaluated at a probability level of 0.05, and mean comparisons among the studied factors were performed using the Least Significant Difference (L.S.D.) test.

Studied Characters

1. Length of new vegetative shoots (cm): The length of new vegetative shoots was measured using a metric measuring tape by taking the average length of ten randomly selected new shoots from all sides of each tree. The measurement was taken from the point of attachment of the shoot to the branch on which it had grown.
2. Diameter of new vegetative shoots (mm): The electronic vernier caliper was used to measure the diameter of the same shoots mentioned above, at a distance of 1 cm from the point of attachment to the parent branch.
3. Leaf area (cm^2): The leaf area was determined by selecting ten fully expanded leaves randomly from the middle portion of shoots around all four directions of the tree, after removing the petioles. The method described by**[35]** was followed, which involves tracing the selected leaves on white A4-sized paper of known weight and area using a photocopying machine, then cutting the papers on which the leaf shape was drawn and extracting the leaf area using the following equation.:

$$\text{Leaf area (cm}^2\text{)} = \text{Area of large paper (cm}^2\text{)} \times \frac{\text{Weight of the cut} - \text{out portion (g)}}{\text{Weight of the large paper (g)}}$$

4. Total chlorophyll content in leaves (mg 100 g^{-1} fresh weight): The total chlorophyll content was determined according to the method described by**[26].**
5. Fruit set percentage (%): This trait was calculated by selecting four main scaffold branches of approximately equal length distributed around the tree canopy. The number of flowers was counted when 60–80% of full bloom had occurred. Ten days later, the number of set fruits on the same branches was recorded. The fruit set percentage was then calculated using the following formula:

$$\text{Fruit set (\%)} = \frac{\text{Number of set fruits}}{\text{Total number of flowers}} \times 100$$

6. Fruit drop percentage (%): This percentage was calculated by recording the number of fruits remaining on the labelled branches at harvest stage, and comparing it with the number of fruits recorded at fruit set, according to the following formula:
7.

$$\text{Fruit drop (\%)} = \frac{\text{Number of set fruits} - \text{Number of fruits at harvest}}{\text{Number of set fruits}} \times 100$$

ISSN 2072-3857

8. Total yield per tree (kg tree^{-1}): Fruits were harvested beginning from the second week of May. The fruits picked at each harvest were weighed and recorded, and the cumulative yield per tree was obtained at the end of the season.
9. Fruit weight (g): At maturity, the average fruit weight was determined during the second week of May by weighing ten randomly selected fruits at each harvest using a digital electrical balance.
10. Total soluble solids (TSS, %): The TSS content was estimated using a hand refractometer. The device was first calibrated with distilled water, after which a few drops of juice extracted from the fruits were placed on the prism, and the reading was recorded according to the method described by **[1].**
11. **Acidity (%):** The acidity was determined on the basis of citric acid equivalent, following the method outlined by **[34].**

RESULTS AND DISCUSSION

Table (2) showed the difference in the mean length and diameter of new vegetative shoots to foliar application along with tryptophan. The maximum value was recorded for the two traits at the concentration T2 (200 mg L^{-1}) with 42.91 cm and 5.73 mm, respectively, compared with the control treatment T0 (0 mg L^{-1}), which revealed the lowest value was 39.66 cm and 5.25 mm. Likewise, gibberellic acid (GA_3) was found to significantly impact these two parameters at the G2 concentration, at G2 (100 mg L^{-1}) recording values of 43.19 cm and 5.54 mm, compared with 39.24 cm and 5.49 mm, at control G0 (0 mg L^{-1}), respectively. Soil application of liquid organic fertilizer also had a major impact on both traits. Treatment O1 (150 mL L^{-1}) had the highest mean values of 41.94 cm and 5.67 mm, respectively, whereas the control treatment O0 (0 mL L^{-1}) resulted in the lowest averages of 40.57 cm and 5.37 mm. The interaction between gibberellic acid (GA_3) and tryptophan showed a significant effect on the mean length and diameter of new vegetative shoots. The mean values of 44.93 cm and 5.77 mm, respectively, were the highest with the treatment T2G2 and lowest with the T0G0 treatment, values of 36.90 cm and 5.14 mm, respectively.. Similarly, the relationship between tryptophan foliar sprays and soil applications of liquid organic fertilizer significantly impacted both traits, especially under the T2O1 treatment, which achieved mean values of 43.75 cm and 5.92 mm, compared with the T0O0 treatment, which recorded the lowest values of 39.08 cm and 5.15 mm, respectively. In addition, the interaction between gibberellic acid (GA_3) foliar application and liquid organic fertilizer also resulted in a significant improvement in both parameters. The highest values of 43.88 cm and 5.70 mm were obtained after the G2O1 treatment, while the lowest values were obtained after the G0O0 treatment with values of 38.21 cm and 5.40 mm, respectively.

The interaction of the three study factors resulted in a significant increase in the average length and diameter of new vegetative growth. Treatment T2G2O1 recorded the highest values of 45.61 cm and 6.05 mm, compared to treatment T0G0O0, which recorded the lowest values of 36.02 cm and 5.02 mm, respectively

Table (2) Effect of spraying with tryptophan, gibberellic acid and adding liquid organic fertilizer and their interaction on the length (cm) and the diameter (mm) of new vegetative shoots of apricot cv. " Zaghinia"

		Annual shoot length (cm)			Annual shoot diameter (mm)		
Tryptophan mg L^{-1}	Gabrielic Acid mg L^{-1}	Organic fertilizer ML^{-1}		T×G	Organic fertilizer ML^{-1}		T×G
		O_0	O_1		O_0	O_1	
T_0	G_0	36.02	37.79	36.90	5.02	5.26	5.14
	G_1	39.77	40.42	40.09	5.18	5.35	5.27
	G_2	41.45	42.54	42.00	5.26	5.41	5.34
T_1	G_0	38.87	40.97	39.92	5.53	5.67	5.60
	G_1	40.98	41.04	41.01	5.33	5.75	5.54
	G_2	41.81	43.49	42.65	5.37	5.63	5.50
T_2	G_0	39.76	42.01	40.88	5.65	5.81	5.73
	G_1	42.23	43.62	42.93	5.45	5.92	5.68
	G_2	44.25	45.61	44.93	5.50	6.05	5.77
				Average T			Average T
T×O	T_0	39.08	40.25	39.66	5.15	5.34	5.25
	T_1	40.55	41.83	41.19	5.41	5.68	5.55
	T_2	42.08	43.75	42.91	5.53	5.92	5.73
				Average G			Average G
G×O	G_0	38.21	40.26	39.24	5.40	5.58	5.49
	G_1	40.99	41.69	41.34	5.32	5.67	5.50
	G_2	42.50	43.88	43.19	5.38	5.70	5.54
	Average O	40.57	41.94		5.37	5.67	
			LSD 5%				
	T	G	O	T * G	T * O	G * O	T * G * O
Annual shoot length	0.55	0.55	0.45	0.95	0.77	0.77	1.35
Annual shoot diameter	0.07	0.07	0.06	0.12	0.10	0.10	0.18

ISSN 2072-3857

The data in Table (3) indicated that the study factors showed significant differences. Tryptophan spraying was shown to highly impact both leaf area and total chlorophyll contents (with T2 obtaining 20.98 cm² and 34.76 mg 100 g-1 fresh weight) versus T0 which displayed the lowest values of 19.63 cm² and 32.09 mg 100 g-1 fresh weight, respectively. By means of identical experiment, spraying gibberellic acid significantly influenced such two traits, especially at concentration (G2), which showed the values of 21.23 cm² and 34.79 mg/100 g⁻ ¹ fresh weight (both in total) compared to concentration (G0), which showed the values of 19.33 cm² and 31.45 mg/100 g⁻ ¹ fresh weight in total,

respectively. The application of organic fertilizer to the soil also had an effect. The significant effect of the liquid is these two properties, especially the concentration (O1), which recorded values of 20.31 cm2 and 34.93 mg 100 g^{-1} soft weight, compared to the concentration (O0), which had the lowest values of 19.96 cm2 and 31.93 mg 100 g^{-1} soft weight, respectively. The effect of the interaction between foliar spraying of tryptophan and gibberellic acid was significant on leaf area and total leaf chlorophyll content , especially the T2G2 treatment, which recorded values of 22.95 cm^2 and 36.61 mg per 100 g fresh weight, compared to the T0G0 treatment that recorded the lowest values of 19.20 cm^2 and 30.35 mg per 100 g fresh weight , respectively. The interaction between spraying with tryptophan and gibberellic acid also significantly affected these two traits, particularly the T2O1 treatment, which achieved values of 21.13 cm^2 and 36.54 mg per 100 g fresh weight , compared to the T0G0 treatment, that recorded the lowest values of 19.47 cm^2 and 30.96 mg per 100 g fresh weight , respectively. Additionally , the interaction between spraying with gibberellic acid and adding liquid organic fertilizer showed a significant superiority in both trails, especially in the G2O1 treatment which recorded values of 21.64 cm^2 and 36.70 mg per 100 g fresh weight , compared to the G0O0 treatment that achieved the lowest values of 19.26 cm^2 and 30.16 mg per 100 g fresh weight , respectively. Three-way interaction significantly affected the leaf area and total chlorophyll content of the leaves, especially the T2G2O1 treatment, which gave values of 23.29 cm2 and 39.06 mg/100 g-1 fresh weight, compared to the T0G0O0 treatment, which achieved the lowest values of 19.12 cm2 and 28.58 mg/100 g-1 fresh weight, respectively.

Table (3) Effect of spraying with tryptophan, gibberellic acid and adding liquid organic fertilizer and their interaction on leaf area (cm^2) and total chlorophyll content in leaves (mg per 100 g fresh weight) of apricot cv. "Zaghinia"

		Leaf area (cm2)			Chlorophyll (mg g-1)		
Tryptophan mg L^{-1}	**Gabrielic Acid mg L^{-1}**	**Organic fertilizer ML^{-1}**		**T×G**	**Organic fertilizer ML^{-1}**		**T×G**
		O_0	**O_1**		**O_0**	**O_1**	
T_0	**G_0**	**19.12**	**19.28**	**19.20**	**28.58**	**32.11**	**30.35**

ISSN 2072-3857

	G_1	19.40	19.54	19.47	32.66	32.19	32.42
	G_2	19.89	20.53	20.21	31.64	35.38	33.51
T_1	G_0	19.33	19.43	19.38	29.95	32.59	31.27
	G_1	19.48	19.55	19.51	32.75	36.80	34.78
	G_2	19.90	21.10	20.50	32.83	35.67	34.25
T_2	G_0	19.34	19.49	19.41	31.96	33.50	32.73
	G_1	20.50	20.62	20.56	32.83	37.07	34.95
	G_2	22.64	23.29	22.96	34.16	39.06	36.61
				Average T			Average T
T×O	T_0	19.47	19.78	19.63	30.96	33.23	32.09
	T_1	19.57	20.03	19.80	31.85	35.02	33.43
	T_2	20.83	21.13	20.98	32.99	36.54	34.76
				Average G			Average G
G×O	G_0	19.26	19.40	19.33	30.16	32.73	31.45
	G_1	19.79	19.90	19.85	32.75	35.35	34.05
	G_2	20.81	21.64	21.23	32.88	36.70	34.79
	Average O	19.96	20.31		31.93	34.93	
			LSD 5%				
	T	G	O	T * G	T * O	G * O	T * G * O
Leaf area	0.38	0.38	0.31	0.65	0.53	0.53	0.93
Chlorophyll	0.89	0.89	0.73	1.54	1.26	1.26	2.19

Results in Table (4) showed significant differences in fruit set percentage and fruit drop percentage as an effect of the studied factors. Foliar spraying with tryptophan significantly increased fruit set and decreased fruit drop, particularly at concentration T2 (200 mg L⁻ ¹), which were 43.30% and 50.81%, respectively, compared with T0 (0 mg L⁻ ¹), 42.08% and 51.94% respectively. Likewise, foliar application of gibberellic acid (GA_3) led to a substantial increase in fruit set percentage with a corresponding reduction in fruit drop. The treatment G2 (100 mg L⁻ ¹) reached mean values of 44.97% and 49.66% respectively, in comparison with the control G0 (0 mg L⁻ ¹), with the lowest fruit set (39.76%) and also the highest fruit drop (53.14%). Furthermore, soil liquid organic fertilizer application had a significant effect on both variables. The treatment O1 (150 mL L⁻ ¹) resulted in the most fruit set (43.50%) and the least fruit drop (50.68%), while the control O0 (0 mL L⁻ ¹) had the least amount of fruit set 41.91% and most fruit drop 52.18%. The interaction between spraying with tryptophan and gibberellic acid had a significant effect on the fruit set and fruit drop percentages, particularly the T2G2 treatment, which recorded the highest fruit set percentage of 45.68% and the lowest fruit drop percentage of 45.68% , compared to the T0G0 treatment, which achieved values of 38.85% and 53.75% , respectively. Meanwhile, the interaction between spraying with tryptophan and adding liquid organic fertilizer resulted in a significant reduction in fruit drop, especially in the T2O1 treatment , which reached 49.96%,

ISSN 2072-3857

compared to the T0O0 treatment, which recorded the lowest percentage of 52.54%. Furthermore, the interaction between spraying with gibberellic acid and adding liquid organic fertilizer showed a significant decrease in fruit drop, particulariy in the G2O1 treatment with values reaching 48.96% , compared to the G0O0 treatment, which achich achieved the highest percentage of 54.41%. The three-way interaction of the study factors showed a significant superiority in the fruit set percentage, especially the T2G2O1 treatment, which recorded the highest percentages of 47.07%, compared to the T0G0O0 comparison treatment, which gave the lowest value of 37.75%.

Table (4) Effect of spraying with tryptophan, gibberellic acid and adding liquid organic fertilizer and their interaction on the percentage of fruit set (%) and the percentage of fruit drop (%) of apricot cv. "Zaghinia"

		Contract Percentage (%)			Percentage of fallen fruits (%)		
Tryptophan mg L-1	**Gabrielic Acid mg L-1**	**Organic fertilizer ML-1**		**T×G**	**Organic fertilizer ML-1**		**T×G**
		O_0	**O_1**		**O_0**	**O_1**	
T_0	**G_0**	**37.75**	**39.95**	**38.85**	**54.85**	**52.65**	**53.75**
	G_1	**42.52**	**43.87**	**43.20**	**52.01**	**51.72**	**51.87**
	G_2	**44.06**	**44.35**	**44.20**	**50.77**	**49.64**	**50.20**
T_1	**G_0**	**38.94**	**40.63**	**39.78**	**54.48**	**51.75**	**53.11**
	G_1	**42.79**	**43.98**	**43.39**	**51.92**	**51.24**	**51.58**
	G_2	**44.18**	**45.86**	**45.02**	**50.62**	**49.22**	**49.92**
T_2	**G_0**	**39.65**	**41.68**	**40.66**	**53.92**	**51.20**	**52.56**
	G_1	**43.03**	**44.10**	**43.56**	**51.32**	**50.68**	**51.00**
	G_2	**44.28**	**47.07**	**45.68**	**49.74**	**48.02**	**48.88**
				Average T			**Average T**
T×O	**T_0**	**41.45**	**42.72**	**42.08**	**52.54**	**51.33**	**51.94**
	T_1	**41.97**	**43.49**	**42.73**	**52.34**	**50.73**	**51.53**
	T_2	**42.32**	**44.28**	**43.30**	**51.66**	**49.96**	**50.81**
				Average G			**Average G**
G×O	**G_0**	**38.78**	**40.75**	**39.76**	**54.41**	**51.86**	**53.14**
	G_1	**42.78**	**43.98**	**43.38**	**51.75**	**51.21**	**51.48**
	G_2	**44.17**	**45.76**	**44.97**	**50.37**	**48.96**	**49.66**
	Average **O**	**41.91**	**43.50**		**52.18**	**50.68**	
			LSD 5%				
	T	**G**	**O**	**T * G**	**T * O**	**G * O**	**T * G * O**
Contract Percentage	**0.66**	**0.66**	**0.54**	**1.14**	**N.S**	**N.S**	**1.16**
Percentage offallenfruits	**1.04**	**1.04**	**0.85**	**1.80**	**1.47**	**1.47**	**N.S**

ISSN 2072-3857

Results from Table (5) showed that the investigated factors varied significantly regarding the total yield per tree and fruit weight. Foliar spraying with tryptophan was a promising treatment, and T2 (200 mg L^{-1}) had the greatest mean values of 12.91 kg tree^{-1} and 22.95 g compared to T0 (0 mg L^{-1}), with 12.21 kg tree^{-1} and 22.49 g. Foliar treatment of gibberellic acid (GA$_3$) showed a positive effect on both parameters. The highest mean values of 13.86 kg tree^{-1} and 23.70 g were obtained at the concentration G2 (100 mg L^{-1}) as compared to the lowest mean values obtained of 11.25 kg tree^{-1} and 21.65 g by the concentration G0 (0 mg L^{-1}), respectively. In addition, the effect of liquid organic fertilizer during soil application was also significant, with the treatment O1 (150 mL L^{-1}) showing the highest mean values of 13.03 kg tree^{-1} and 23.06 g and the O0 (0 mL L^{-1}) treatment showing the lowest mean values of 12.01 kg tree^{-1} and 22.23 g, respectively. The response of foliar application of tryptophan with gibberellic acid (GA$_3$) had a significant effect on total yield per tree and fruit weight. The mean values for T2G2 treatment were 14.38 kg tree^{-1} and 24.47 g, respectively, while that for T0G0 treatment was lowest at 10.75 kg tree^{-1} and 21.61 g, respectively. Similarly, there was a major impact on these two parameters due to the interaction between foliar spraying of tryptophan and soil application of liquid organic fertilizer. T2O1 showed the highest mean values of 13.37 kg tree^{-1} and 23.59 g, but the T0O0 treatment showed the mean values of 11.62 kg tree^{-1} and 22.19 g, respectively. Finally, the interaction of gibberellic acid spraying and soil application of liquid organic fertilizer has a significant effect on both characteristics. The G2O1 treated group achieved 14.57 kg tree^{-1} and 24.43 g, the highest average values, while that of G0O0 treatment group achieved 10.55 kg tree^{-1} and 21.27 g, the lowest mean values. The effects of the studied factors were substantial on total yield per tree and fruit weight owing to three-way interaction. The T2G2O1 treatment recorded the highest mean values of 14.92 kg tree^{-1} and 25.92 g, respectively, as compared to T0G0O0 treatment, which reported the lowest values of 9.80 kg tree^{-1} and 21.27 g.

Table (5) Effect of spraying with tryptophan, gibberellic acid and adding liquid organic fertilizer and their interaction on the total yield (per tree^{-1}) and fruit weight (g) of apricot cv. "Zaghinia"

		Total yield of the tree (kg tree^{-1})			Fruit weight (g)		
Tryptophan mg L-^{1}	**Gabrielic Acid mg L^{-1}**	**Organic fertilizer ML^{-1}**		**T×G**	**Organic fertilizer ML^{-1}**		**T×G**
		O_0	**O_1**		**O_0**	**O_1**	
T_0	**G_0**	**9.80**	**11.70**	**10.75**	**21.22**	**22.00**	**21.61**
	G_1	**12.28**	**12.34**	**12.31**	**22.43**	**22.70**	**22.57**
	G_2	**12.79**	**14.39**	**13.59**	**22.92**	**23.66**	**23.29**

T_1	**G_0**	**10.78**	**11.75**	**11.26**	**21.25**	**22.02**	**21.63**
	G_1	**12.30**	**12.56**	**12.43**	**22.45**	**22.72**	**22.58**
	G_2	**12.82**	**14.41**	**13.62**	**22.95**	**23.71**	**23.33**
T_2	**G_0**	**11.09**	**12.39**	**11.74**	**21.35**	**22.05**	**21.70**
	G_1	**12.42**	**12.81**	**12.61**	**22.53**	**22.81**	**22.67**
	G_2	**13.84**	**14.92**	**14.38**	**23.02**	**25.92**	**24.47**
				Average T			**Average T**
T×O	**T_0**	**11.62**	**12.81**	**12.21**	**22.19**	**22.79**	**22.49**
	T_1	**11.97**	**12.90**	**12.43**	**22.21**	**22.81**	**22.51**
	T_2	**12.45**	**13.37**	**12.91**	**22.30**	**23.59**	**22.95**
				Average G			**Average G**
G×O	**G_0**	**10.55**	**11.94**	**11.25**	**21.27**	**22.02**	**21.65**
	G_1	**12.33**	**12.57**	**12.45**	**22.47**	**22.74**	**22.61**
	G_2	**13.15**	**14.57**	**13.86**	**22.96**	**24.43**	**23.70**
	Average **O**	**12.01**	**13.03**		**22.23**	**23.06**	
			LSD 5%				
	T	**G**	**O**	**T * G**	**T * O**	**G * O**	**T * G * O**
Total yield of the tree	**0.55**	**0.55**	**0.45**	**0.95**	**0.77**	**0.77**	**1.35**
Fruit weight	**0.38**	**0.38**	**0.31**	**0.65**	**0.53**	**0.53**	**0.93**

Table (6) summarizes that both total soluble solids (TSS) and total acidity (TA) were significantly affected by the studied factors. Foliar treatment of tryptophan at T2 concentration (200 mg L^{-1}) showed higher TSS- and TA-related percentage (13.72% & 1.08%) than in the control T0 (0 mg L^{1}) (13.25% and 1.15%, respectively). Similarly, foliar spraying with gibberellic acid (GA) had the highest TSS (14.11%) and lowest TA (1.06%) with the high and low G2 (100 mg L^{1}) and control G0 (0 mg L^{1}) treatment respectively; for G0 (0 mg L^{1}) for instance the total soluble solids (TSS) was 12.97% and 1.17%. Additionally, both criteria were significantly changed by applications of liquid organic fertilizer. O1 (150 mL L^{1}) treatment obtained the highest TSS (13.73%) and lowest TA fraction (1.07%), while O0 (0 mL L^{1}) recorded 13.28% and 1.16%, respectively. Both traits were significantly affected by the foliar application of tryptophan and gibberellic acid (GA_3). In comparison, the highest TSS (14.35%) and lowest TA (1.02%) value for T2G2 Treatment were noted while T0G0 Treatment recorded the lowest TSS value (12.77%) with a relatively higher TA (1.19%) respectively. In the context of chemical interaction between tryptophan spray treatment and soil application of liquid organic fertilizer, the T2O1 treatment achieved the highest TSS value (13.92%), and T0O0 treatment displayed the lowest TSS value (12.99%). In respect to the interaction between gibberellic acid spraying and the soil application of liquid organic fertilizer, however, a superior effect was found for the G2O1 treatment, which had the highest TSS percentage (14.35%), which was significantly better than the G0O0 treatment which had the lowest (12.73%).

Table (6) Effect of spraying with tryptophan, gibberellic acid and adding liquid organic fertilizer and their interaction on the total soluble solids (%) and acidity (%) of apricot cv. "Zaghinia"

		Total Soluble solids percentage (%)			**Titratable acidity (%)**		
Tryptophan mg L^{-1}	**Gabrielic Acid mg L^{-1}**	**Organic fertilizer ML^{-1}**		**T×G**	**Organic fertilizer ML^{-1}**		**T×G**
		O_0	**O_1**		**O_0**	**O_1**	
T_0	**G_0**	**12.51**	**13.04**	**12.77**	**1.24**	**1.15**	**1.19**
	G_1	**12.92**	**13.38**	**13.15**	**1.20**	**1.10**	**1.15**
	G_2	**13.56**	**14.12**	**13.84**	**1.15**	**1.07**	**1.11**
T_1	**G_0**	**12.71**	**13.18**	**12.94**	**1.21**	**1.12**	**1.16**
	G_1	**13.30**	**13.75**	**13.52**	**1.16**	**1.07**	**1.11**
	G_2	**13.96**	**14.36**	**14.16**	**1.10**	**1.01**	**1.05**
T_2	**G_0**	**12.98**	**13.40**	**13.19**	**1.19**	**1.11**	**1.15**
	G_1	**13.46**	**13.81**	**13.63**	**1.13**	**1.03**	**1.08**
	G_2	**14.13**	**14.57**	**14.35**	**1.07**	**0.98**	**1.02**
				Average T			**Average T**
T×O	**T_0**	**12.99**	**13.51**	**13.25**	**1.19**	**1.10**	**1.15**
	T_1	**13.32**	**13.76**	**13.54**	**1.15**	**1.06**	**1.11**
	T_2	**13.52**	**13.92**	**13.72**	**1.13**	**1.04**	**1.08**
				Average G			**Average G**
G×O	**G_0**	**12.73**	**13.20**	**12.97**	**1.21**	**1.12**	**1.17**
	G_1	**13.22**	**13.64**	**13.43**	**1.16**	**1.06**	**1.11**
	G_2	**13.88**	**14.35**	**14.11**	**1.10**	**1.02**	**1.06**
	Average **O**	**13.28**	**13.73**		**1.16**	**1.07**	
			LSD 5%				
	T	**G**	**O**	**T * G**	**T * O**	**G * O**	**T * G * O**
T. S. S	**0.44**	**0.44**	**0.36**	**0.76**	**0.62**	**0.62**	**N.S**
T. A	**0.061**	**0.061**	**0.050**	**0.106**	**N.S**	**N.S**	**N.S**

Tryptophan is an amino acid with a dual physiologic function in plants, since it is found in structural and enzymatic proteins and it acts as a physiologically necessary precursor for auxins biosynthesis, indole-3-acetic acid (IAA) in particular, essential in controlling cell proliferation, cell expansion and tissue differentiation **[37].** Conversion of tryptophan leads to an increase in auxin level, which induces the process of

ISSN 2072-3857

elongation, activation of expansin enzymes and other cell wall loosening enzymes to hydrolyze hydrogen bonds of the cell wall matrix. This enzymatic activation favors and expands the cell wall, increasing elongation rates in developing body tissues, inducing shoot elongation. Concurrently, auxins also enhance cambial responses, which in turn promote new vascular cell proliferation **[39],** consequently producing a higher shoot diameter and improved nutrient and water transfer systems in the plant. The enhanced leaf surface area after the tryptophan effect is ascribed to its stimulatory action on mesophyll tissue differentiation along with active cellular proliferation in the leaf. In addition, auxins derived from tryptophan actively stimulate chloroplast biogenesis and govern photosystem I and II gene expression levels **[32]**. The cumulative result is that the total chlorophyll content increases with these structural and functional properties. Improvements in leaf organisation and photosynthetic efficiency would increase the rate of carbon fixation and carbohydrate production which are channeled towards flowering and fruiting organs and hence increase the percentage fruit set. In addition, auxins from tryptophan metabolite inhibit the formation of the abscission layer by inhibiting cellulase and pectinase enzyme activity which lowers the percentage fruit drop **[13].** Such metabolic and hormone changes are responsible for the rise in total fruit productivity per tree. Tryptophan has a significant role in regulating sugar metabolism and transfer in the phloem. In addition, auxin biosynthesis stimulation increases the workload of enzymes in the respiratory and glycolytic systems and as for the latter is required to bring ATP energy and carbon material to bear for the fruit cell extension. Hence, this metabolic modulation brings with it additional weight of fruit **[15].** With respect to total soluble solids (TSS), photosynthetic assimilation and phloem translocation effectiveness increase and enhance the accumulation capacity of soluble sugars sucrose, fructose and glucose present in the fruit juice. Tryptophan also increases the activity of carbohydrate-utilizing enzymes (sucrose synthase, invertase) that enhance the free sugars contents—and hence, TSS values. At the same time, increased use of organic acids in respiration and metabolic reconversion during fruit ripening results in decreased total titratable acidity (TA) due to the conversion of acids into sugars and Krebs cycle intermediates. As a result, increased fruit flavor balance is realized **[7].** This result was consistent with those given by **[30]** and **[12].**

Gibberellic acid (GA3) is one of the vital hormonal regulators of growth in plants, and this hormone is a major inducer of gene expression that helps regulate the balance between cell division and cell elongation. It also activates many various growth-related genes involved in the synthesising of structural proteins as well as cell wall–modifying enzymes, including expansins, pectin methylesterase, cellulase, and xyloglucan endo-transglucosylase/hydrolase (XTH). These enzymes act synergistically so that they disrupt hydrogen bonds among cell wall components, leading to greater extensibility of the cell wall, expansion, and thus shoot lengthening **[38].** GA3 can also lead to increased cambial cell division and an increase in shoot diameter due to the formation and differentiation of new xylem and phloem cells. The greater cross-sectional area improves vascular conductivity, thereby facilitating the transport of water and mineral nutrients towards the growing shoot tips **[21].** Leaves respond to gibberellin by expanding the leaf, due to enhanced activity of cell wall-modifying enzymes in leaf tissues. This works to increase the number and size of mesophyll cells, and subsequently light interception of leaf light. Gibberellin also activates the biosynthesis of chlorophyll, promoting the activity of chlorophyll synthase, 5-aminolevulinic acid synthase, and protochlorophyllide reductase, contributing to the total levels of chlorophyll. The photosynthetic efficiency of this increases, leading to the increase in translocatable carbohydrate accumulation in the phloem and early floral formation which in turn increases the number of fruit sets. Regarding the decreased fruit drop, gibberellin works by preventing certain enzymes of abscission layer formation such as polygalacturonase, cellulase, and pectin esterase, by decreasing the sensitivity of the cells of the abscission zone to ethylene and abscisic acid. This repression leads to a reduction in the number of abscised fruits **([20]; [15]).** The more fruits there were and the more carbon compounds passing through the phloem, the greater quantity of sugars and structural metabolites accumulated in the fruit tissues; this resulted in increased fruit weight and total yield per tree. The action of GA3 on fruit ripening is sustained by the activation of enzymes that aid in metabolic conversions (e.g., malate dehydrogenase and citrate synthase), with the progressive consumption of organic acids via the Krebs cycle leading to decreased total titratable acidity (TA) in fruits. Simultaneously, accumulation of soluble sugars resulting from starch hydrolysis increases the TSS content of the fruit **[24]** Such results are consistent with the results of **[4]** and **[8]**

The increase in vegetative growth traits resulting from the application of liquid organic fertilizer may be attributed to its content of humic and fulvic acids, which stimulate root proliferation by activating plasma membrane tt^{+}–ATPase enzymes. This activation leads to proton pumping into the rhizosphere, causing rhizosphere acidification, which in turn enhances nutrient solubility and promotes ion absorption. Such root activity improves the accumulation of nitrogen and potassium within the vascular tissues, thereby enhancing the metabolic efficiency of the aerial parts **[9].** In addition, steady and regulated consumption of organic nitrogen activates enzymes of amino acids and structural proteins, including glutamine synthetase (GS), and glutamate synthase (GOGAT). Because of this, the formation of protoplasm is greater and the cellular division of the shoot is also enhanced that results from a favourable effect on shoot elongation (stimulation of apical meristems), increase in shoot thickening (in relation to increase in cambial activity, and the formation of new vascular tissues) **([24]; [36]).** Moreover, organic acids result in auxins and cytokinin’s formation or increasing their bioactive responsiveness of the plant, and as a result vigorous vegetative growth, leaf expansion. This expansion directly correlates with an increase in chlorophyll content, attributed to an activation of 5-aminolevulinic acid dehydratase and chlorophyll synthase, essential enzymes in chlorophyll biosynthesis. The organic carbon content of the fertilizer also increases the levels of intermediate metabolites of the carbon cycle, promoting the photosynthetic efficiency and leading to higher yield and carbohydrate production of the leaves. This enhancement facilitates the translocation of the assimilates towards the flowers, providing them with more nutrients and thereby increasing the set percentage of fruit. The decrease in percentage of fruit drop (PD) with liquid organic fertilizer can be assumed to be the effect that humic and fulvic acids had on increasing calcium, magnesium, and

ISSN 2072-3857

phosphorus uptake and these properties can reinforce the cell walls of the abscission layer tissues. This, in its turn, inhibits the degradation of pectin enzymes, including polygalacturonase and pectin methylesterase to decrease the amount of fruit abscission **[23].** As a consequence in fruit set and fruit drop, improved photosynthesis and nutritional status of the individual is followed up with an increase in biomass production which positively affects the total yield per tree. In fruit, seen in the growth of fruit weight may be the result of an increased rate of cell enlargement, from the accumulation of sugars and osmotic compounds in fruit cells. Potassium is also essential to the control of sugar transport enzymes that reduce sucrose to simple sugars such as sucrase synthase and invertase, which serve as sugar-transporting proteins that raise the osmotic pressure in the vacuoles of fruit and thus encourage swelling by the uptake of water and solute into the fruit **[40].** This process leads to increased total soluble solids (TSS) in the sample. Moreover, the ionic balance provided by potassium and organic nitrogen increases respiratory metabolism and activates Krebs cycle enzymes, resulting in the degradation of organic acids and a decrease in total titratable acidity (TA) **[18].** The findings are corroborated by those of **[5]** and **[6].**

CONCLUSION

The results obtained through the study indicate the superiority of the high concentrations of the study factors that were used when spraying the Zagenia apricot trees with tryptophan, gibberellic acid and the soil addition of liquid organic fertilizer,These higher concentrations resulted in increasing vegetative characteristics, improving the fruit set percentage, increasing the yield quantity and increasing its chemical content.

References

[1]A.O.A.C. (1980). Official Methods of Analysis 13th of Association of Ficial Analytical Chemists – Washington, dc.

[2]Abukhalaf, M., C. Proksch, D. Thieme, J. Ziegler and W. Hoehenwarter. (2023). Changing turn-over rates regulate abundance of tryptophan, GS biosy6nthesis, IAA transport and photosynthesis proteins in Arabidopsis growth defense transitions. BMC Biol., 21(1): 249. doi: 10.1186/s12915-023-01739-3.

[3]Alburquerque, N., D. Ruiz, L. Burgos and C. Petri.(2020). Apricot Prunus armeniaca L. In: Biotechnology of fruit and nut crops. CABI, pp. 496-505.

[4]Al-Doori, M. F., R. A. Medan and S. A. Hussein. (2020). Effect of spray with some growth regulators and zinc on growth and yield of pear trees (*Pyrus Communis* L.). International Journal of Agricultural and Statistical Sciences, 16(1): 1181-1186.

ISSN 2072-3857

[5]Al-Hawezy, Sh. M. N. and Ch. A. Ibrahim. (2018). Foliar application of bread yeast and organic fertilizer to improve vegetative characters of Thompson Seedless Grape vine (*Vitis vinifera* L.). Journal of Zankoy Sulaimani Part-A- (Pure and Applied Sciences), 1(Special issue): 291-300.

[6]Al-Hayyani, M. A. M. and M. A. A. Al-Hadithi. (2023). The effect of adding organic fertilizer and spraying with glutathione and kaolin on some growth traits of apricot seedlings of the Red Luminous variety. Master's Thesis, College of Agricultural Engineering Sciences - University of Baghdad, Iraq.

[7]**Ali, M., Y. Pan, H. Liu and Z. Cheng (2023).** Melatonin interaction with abscisic acid in the regulation of abiotic stress in Solanaceae family plants. Front. Plant Sci., 14:1271137. https://doi.org/10.3389/fpls.2023.1271137

[8]Al-Janabi, A. M. I.(2024). Impact Of Gibberellic Acid And Boron Trioxide Nanoparticles Foliar Spraying On Growth, Yield And Fruit Quality Of " ZAGHINIA" Apricot Trees. Anbar Journal of Agricultural Sciences, 22(2), 1557-1569.

[9]Allouzi, M. M. A., S. M. A. Allouzi, Z. X. Keng, C. V. Supramaniam, A. Singh and S. Chong.(2022). Liquid biofertilizers as a sustainable solution for agriculture. Heliyon, 8(12): e12609. https://doi.org/10.1016/j.heliyon.2022.e12609

[10]Al-Mohammedi, Sh. M. and F. M. Al-Mohammadi. (2012). Statistics and experiments design. Dar Osama for Publishing and Distribution, Amman - Jordan.

[11]Al-Soufi, M. H., H. A. Alshwyeh, H. Alqahtani, S. K. Al-Zuwaid, F. O. Al-Ahmed, F. T. Al-Abdulaziz, D. Raed, K. Hellal, N. H. Mohd Nani, and S. N. Zubaidi.(2022). A Review with updated perspectives on nutritional and therapeutic benefits of apricot and the Industrial،application of its underutilizedpartsMolecules,27:5016.https://doi.org/10.3390/molecules27155016

[11]Alwan, Jasim Muhammad. (2017). Drip Fruit Technology. First Edition. Dijlah Library for Printing, Publishing, and Distribution. Baghdad - Iraq.

[12]Awad, M. R. (2023). Response of "Le Conte" cv. Pear trees to some bioStimulants foliar applications. Journal of the Advances in Agricultural Researches (JAAR), 28(3): 658-671. DOI: 10.21608/JALEXU.2023.225142.1148

[13]Bai, B., O. Novak, K. Ljung, j. Hanson and L. Bentsink. (2018). Combined transcriptome and translatome analyses reveal a role for tryptophan-dependent auxin biosynthesis in the control of DOG1-dependent seed dormancy new Phytol.217(3):1077-1085. https://doi.org/10.1111/nph.14885

[14]Central Statistical the device. (2021). appreciation Summer Fruit Tree Production. Agricultural Statistics Directorate. Ministry of Planning - Iraq.

[15]Davies, P. J. (2010). The plant hormones: their nature, occurrence, and functions. In: Davies, P. J. (Eds.) Plant hormones: biosynthesis, signal transduction, Action!. Springer, Dordrecht, PP: 1, 15. https://doi.org/10.1007/978-1-4020-2686-7_1

[16]D'Mello, J. P. F. (2015). Amino acids in higher plants. Formerly Scottish Agriculture College, UK. 632P.

[17]FAOSTAT. (2023). Food and Agriculture Organization (FAO) of the United Nation .Available in: http://www.fao.org/faostat/en/#data/QCL

[18]Gawai, K. J. and S. K. Gudadhe. (2023). Effect of liquid organic fertilizer on soil quality. International Journal of Ecology and Environmental Sciences, 5(1): 1-3.

[19]Griffiths, J., A. Rizza, B. Tang, W. B. Frommer and A. M. Jones. (2024). Gibberellin Perception Sensor 2 reveals genesis and role of cellular GA dynamics in light-regulated hypocotyl growth. The Plant Cell, 36(10): 4426-4441. https://doi.org/10.1093/plcell/koae198

[20]He, J., P. Xin, X. Ma, J. Chu and G. Wang. (2020). Gibberellin metabolism in flowering plants: an update and perspectives. Front Plant Sci., 11: 532-558. doi: 10.3389/fpls.2020.00532.

[21]Hedden, P. (2020). The current status of research on gibberellin biosynthesis. Plant Cell Physiol., 61(11): 1832-1849. doi: 10.1093/pcp/pcaa092.

[22]Hussain ،S. Z. ،B. Naseer ،T ،Qadri ، T ،Fatima and T. A. Bhat. (2021). Apricot (Prunus armeniaca) – morphology ، taxonomy ،composition and health benefit. In: Fruits grown in highland regions of Himalayas. Springer ،Cham. pp. 91-102.

[23]Ji, R., G. Dong, W. Shi and J. Min. (2017). Effects of liquid organic fertilizers on plant growth and rhizosphere soil characteristics of chrysanthemum. Sustainability, 9(5): 841-857. https://doi.org/10.3390/su9050841

[24]Kaur, G. (2019). A review of XET enzymes, current applications and future trends. International Journal of Latest

ISSN 2072-3857

Technology in Engineering, Management & Applied Science (IJLTEMAS), 8(11): 52-55.

[25]Khan, M. I. R., A. Singh and P. Poor. (2023). Plant hormones in crop production. 1st Edition. Academic Press. DOI: 10.1016/C2021-0-00160-7

[26]Knudson, L.L., T.W. Tibbitts and G.E. Edwards (1977). Measurement of ozone injury by determination of leaf chlorophyll concentration. Plant Physiol.

[27]Liu, W. C., R. F. Song, S. Q. Zheng, T. T. Li, B. L. Zhang, X. Gao and Y. T. Lu. (2022). Coordination of plant growth and abiotic stress responses by tryptophan synthase β subunit 1 through modulation of tryptophan and ABA homeostasis in Arabidopsis. Mol. Plant. 15(6): 973-990. **https://doi.org/10.1016/j.molp.2022.04.009**

[28]Lurie, S. (2010). Plant growth regulators for improving postharvest stone fruit quality.Acta.Horticulturae,884:189-197.

https://doi.org/10.17660/ActaHortic.2010.884.21

[29]Mastro, F. D., G. Brunetti, K. Farrag and H. Zang. (2025). Organic fertilizers in horticulture. 173p. Horticultrae, **https://doi.org/10.3390/books978-3-7258-3876-9**

[30]Mosa, W. F. A (2021). The use of liquid organic fertilizers as sustainable alternatives in fruit orchards. Journal of Soil Science and Plant Nutrition, 21(2), 991-1004.

[31]Moustafa, K. and J. Cross. (2019). Production, pomological and nutraceutical properties of apricot. J Food Sci. Technol., 56: 12-23. https://doi.org/10.1007/s13197-018-3481-7

[32]Nawaz, K., R. Chaudhary, A. Sarwar, B. Ahmad, A. Gul, C. Hano, B. H. Abbasi, and S. Anjum. (2020). Melatonin as master regulator in plant growth, development and stress alleviator for sustainable agricultural production: current status and future perspectives. Sustainability, 13:294. https://doi.org/10.3390/su13010294

[33]Radi, M., Mahrouz, M., Jaoad, A. and Amiont, M. A. (2003). Influence of mineral fertilization (NPK) on quality of apricot fruit (cv. Canino), the effect of the mode of nitrogen supply. Agronomie, 23: 737-745.

[34]Ranganna, S. (1995). Handbook of analysis and quality control for fruits and vegetable production. Tata McGraw, Hill Publishing Company Limited, New Delhi. PP: 68, 70.

[35]Saieed, N. T. (1990). Studies of variation in primary productivity growth and morphology in relation to the selective improvement of broad - leaved trees pacies. Ph. D Thesis National United Ireland.

[36]Samalova, M., A. Melnikava, K. Elsayad, A. Peaucelle, E. Gahurova, J. Gumulec, I. Spyroglou, E. V. Zemlyanskaya, E. V. Ubogoeva, D. Balkova, M. Demko, N. Blavet, P. Alexiou, V. Benes, G. Mouille and J. Hejatko. (2023). Hormone-regulated expansins: Expression, localization, and cell wall biomechanics in Arabidopsis root growth. Plant Physiol.. 194(1): 209-228. doi: 10.1093/plphys/kiad228.

ISSN 2072-3857

[37]Solanki, M. and L. I. Shukla. (2023). Recent advances in auxin biosynthesis and homeostasis. 3 Biotech 13: 290. https://doi.org/10.1007/s13205-023-03709-6

[38]Thomas, S. G., M. A. Blázquez D. and Alabadí. (2016). Della proteins: master regulators of gibberellin-responsive growth and development. In Annual Plant Reviews, 49: 189-228 (eds Hedden P. and S. G., Thomas). https://doi.org/10.1002/9781119210436.ch7

[39]Wang ،S.، X. Zhang ،D. H. Gong ،Q. Q. Huang ،W. M. W. W. Kandegama ،M. I. Georgiev ،Y. Y. Gao ،P. Liao and G. F. Hao. (2025). Sophisticated crosstalk of tryptophan-derived metabolites in plant stress responses. Plant Comm. ،6: 101425. https://doi.org/10.1016/j.xplc.2025.101425

[40]Zorb, C., M. Senbayram and E. Peiter. (2014). Potassium in agriculture--status and perspectives. J Plant Physiol., 171(9): 656-69. doi: 10.1016/j.jplph.2013.08.008.

ISSN 2072-3857