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Efficacy Of Ga_3 Primer And Foliar Spray Of Amino Acid (Tryptophan) On Growth Of Two Tulip Plant Cultivars (*Tulipa Gesneriana* L.)

Yousif Ali Abdulrahman [1] **Nizeek Moslih Anwar** [1]

[1] *Department of Horticulture, College of Agricultural Engineering Sciences, Dohuk University, Duhok, IRAQ*.

*Corresponding Author: yousif.abdulrahman@uod.ac.

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ABSTRACT

The research was carried out in the lath house of Forestry Department / Agricultural Engineering Science College, University of Duhok, Duhok, Iraq, during the period from Oct., 25, 2024 to June, 1, 2025. The study aimed to investigate response of two tulip bulbs cultivars (Apeldoorn and Blushing Apeldoorn) to soaked in different gibberellic acid (GA_3) primer concentrations including: (0, 200 and 400 mg L^{-1}) for 24 hours and spray plants with amino acid (Tryptophan) at three concentrations (0, 150 and 300 mg $L^{-1)}$ in each 30 days till flowering. Three factors were used in the factorial Randomized Complete Block Design (RCBD) experiment. Each treatment will consist of 3 replicates and each replicate consisted of 6 pots with diameter 17 cm, The Duncan's Multiple Ranges Test was used to compare the means at a significance level of 5%. The results explained that Apeldoorn cv. was significantly superior to Blushing Apeldoorn cv. in the plant height (18.63 cm), bubllets number (3.26) and total carbohydrate content in leaves (6.25%), while Blushing Apeldoorn cv. was superior significantly in leave area (60.11 cm^2), date to flower opening (148.38 days) and bulbs size (8.11 cm^3). As for effect of gibberellic acid premier it noticed that the both concentrations of GA_3 (200 and 400 mg L^{-1}) appeared a significant effect on dry weight of leaves (1.91 and 1.93 g) and bulblets number (3.39 and 3.06) respectively than control, where GA_3 at concentration (200 mg L^{-1}) affect significantly on vase life of flowers (6.56 days), total chlorophyll content in leaves (69.39%) and total carbohydrates content in leaves (6.49%), on the other hand GA_3 at concentration (400 mg L^{-1}) had a significant impact on plant height (19.73 cm), and flowers stalk length (8.11 cm). Also spray of tryptophan significantly effect on some characteristics of tulip plant includes leaf area (61.72 cm^2), bulblets number (3.50), total chlorophyll content (69.57%) and total carbohydrate content (6.40%) were affected significantly at 150 mg L^{-1} ,but dry weight of leaves (2.03g), bulb size (8.15cm^3) affected with 300 mg L-^{1}.

***Keywords*:** tulip plant cultivars, gibberellic acid, tryptophan.

INTRODUCTION

Tulip plant (*Tulips gesneriana* L.), among the most common bulbous plant in the Liliaceae family, blooms in the spring. It stands out aesthetically from other beautiful flowers due to its unique blossom shape, size, and range of vivid colors. Between 150 and 160 different species of tulips can be produced in gardens. This is in addition to their use as cut flowers. It ranks third in the industry of cut flowers in terms of demand, behind roses and chrysanthemums [1 and 2]. This flower is very important for social occasions like Mother's Day, Valentine's Day, Easter, and the New Year. Its great beauty and many applications are making it more and more popular with people all over the world [3]. The tulip is one of the few cut flowers that are produced commercially, despite its great demand.

Tulip bulbs limited worldwide production is due to their inability to come out of dormancy in unfavorable weather conditions. Due to physiological and physical limitations, flower bulbs that are in a dormant state do not physically grow. Therefore, the most crucial phase in growing tulips wherever in the world is breaking dormancy [4]. The use of various compounds as primers, such as growth regulator (gibberellic acid), can lead to early flowering, improved growth, a shorter forcing period, and a high flower production. Thus, priming as a dormancy-breaking strategy and careful variety selection are crucial steps in tulip production [5, 6, 7and 8]. Pre-planting and soaking bulbs with higher concentrations of GA_3 (200–500 ppm) accelerated the number of spikes per square meter in the study by [9], which

in turn accelerated the initiation of spikes by 65–70 N days and the blooming of flowers by 22–24 days.
Amino acids are nitrogenous chemical molecules that are essential for the synthesis and construction of proteins [10]. They have distinct functions in promoting and sustaining cell growth because they contain basic and acidic groups that serve as catalysts to maximize growth for different types of ornamental plants. They serve as co-enzymes, are a major source of nitrogen, carbon, and energy, which shields the plant from sickness, are a major component of plant hormones, and enhance photosynthesis to promote plant growth [11]. Tryptophan is a hydrophobic amino acid [12] with the structural formula $C_{11}H_{12}N_2O_2$. It is the main biological precursor of the plant hormone (auxin) and is useful in controlling plant growth and process [13]. The purpose of this study is to investigate the response of vegetative growth, flowering, bulbs and bulblets yield of two tulip cultivars to different concentrations of GA_3 primers (soaking) and amino acid (tryptophan) foliar spray.

Materials and Methods

This research was conducted in lath house of Horticulture, Department / College of Agricultural Engineering Sciences, Duhok University included the experiments was conducted for the period from Oct., 15, 2024 to Jun., 1, 2025. The flowering, vegetative growth, and bulb yield of two varieties of tulips namely "Apeldoorn" with red flowers and "Blushing Apeldoorn" with yellow flowers were studied after soaking in different gibberellic acid (GA_3) primers concentrations including: (0, 200 and 400 mg L^{-1}) for 24 hours, then they were planted directly into the pots. And after a month of sprouting the leaves sprayed with tryptophan at three concentrations (control, 150 and 300 mg L^{-1}) at a rate of three sprays to reach the moist state, followed by the initial spray one month later of the emergence of the bulbs and the period between one spray and another is one month. A factorial Randomized Complete Block Design (RCBD) was used to design the experiment with three factors and treatments of (2*3*3=18). There will be three replicates for each treatment, and each replicate will have six pots with diameter of 17 cm. Plastic pots will fill with medium consist of peat moss + loam (1:1), each pot will plant with one bulb with diameter between (2-2.25 cm) for both cultivars on October 25, 2024 in lath house, so this experiment was needed 18*3*5=270 bulbs (135 bulbs for each cultivar), on October 24, 2024 the bulbs and media has been sterilized by fungicide and bacterial (Himex 500 ml) (each liter contain hymexazol (300 gm w/v) at concentration 250 ml L^{-1} by dipping the bulbs in it for a 15 minute and irrigation of medium with solution of fungicide. On March 11, 2025 leaf fertilizer application of NPK (Ava fret (20:20:20+ TE) at 3 gm L^{-1} was spray to maintain plant health after opened whole leaves. The measurements under investigation included the following sprouting of vegetative growth (days), plant hieght (cm), leaf area (cm^2), leaves dry weight (g $plant^{-1}$), date to flowering (days), number of flower $plant^{-1}$, stalk flower length (cm), vas life (day) of cut flowers, total amount of chlorophyll in the leaves (spad unit) and total carbohydrate in leaves (%). SAS program on the computer was used to compare the means under 5%, the data was analyzed using Duncan's Multiple Ranges Test. [14].

Results and Discussions

1- plant height (cm)

The findings in Table (1) demonstrated that there was a notable difference in plant height between the two tulip plant cultivars. The Apeldoorn cultivar had the tallest plant (18.63 cm), while the Blushing Apeldoorn cultivar had the smallest plant (17.94 cm). Also the GA_3 primer had a notable impact on tulip plant height., the soaking of tulip bulbs in 400 mg L^{-1} gave significantly higher plant height (19.73 cm) in comparison with untreated bulbs (control) and 200 mg L^{-1} (17.56 and 17.57 cm) respectively. There is no discernible difference in plant height between amino acid (tryptophan) concentrations. The triple interaction impact between the three elements under study was noteworthy. The maximum plant height achieved through soaking was 20.50 cm. Blushing Apeldoorn cv. bulbs in 400 mg L^{-1} of GA_3 without sprayed plants with tryptophan while the least plant height (15.67 cm) was for treating the same cultivars as a control.

2- Leaf area (cm^2).

The outcomes in Table (2) demonstrated that the leaf area of the two tulip plant varieties differed significantly and the higher leaf area (60.11 cm^2) was for Blushing Apeldoorn cv. while the least area (57.61 cm^2) was for Apeldoorn cv. Plants**.** However, the leaf area increased dramatically with the various tryptophan primer doses of 150 and 300 mg L^{-1}, reaching 61.72 and 59.82 cm^2, respectively, which were significantly greater than the control treatment (55.04 cm^2). The soaked bulbs of Blushing Apeldoorn cv. in 400 mg L^{-1} without tryptophan spray produced a noticeably greater value of leaf area (73.39 cm^2), according to the triple interaction among the three components.

Table (1). Effect of GA_3 primer, amino acid (tryptophan) concentrations on plant height (cm) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	19.63 a-c	17.00 ef	18.57 a-e	18.63 a	
	200	17.13 ef	18.43 a-e	17.27 d-f		
	400	20.00 ab	20.00 ab	19.67 a-c		
Blushing Apeldoorn	0	15.67 f	17.70 c-e	16.80 ef	17.94 b	17.56 b
	200	16.73 ef	18.17 b-e	17.70 c-e		17.57 b
	400	20.50 a	18.77 a-e	19.43 a-d		19.73 a
Tryptophan conc. mean		18.28 a	18.34 a	18.24 a		

Table (2). Effect of GA_3 primer, amino acid (tryptophan) concentrations on leaf area (cm^2) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	52.19 hi	62.91 b-e	64.15 bc	57.61 b	
	200	46.04 i	68.35 ab	59.25 c-f		
	400	50.65 hi	56.48 e-h	58.49 c-g		
Blushing Apeldoorn	0	60.28 c-f	55.10 f-h	56.94 d-g	60.11 a	58.59a
	200	47.68 i	63.73 b-d	61.86 b-f		57.82a
	400	73.39 a	63.73 b-d	58.26 c-g		60.17a
Tryptophan conc. mean		55.04 b	61.72 a	59.82 a		

3- Dry weight of leaves (g)

It may be concluded from Table (3) that there was no discernible difference in the leaves dry weight between two cultivars. A significant variation in dry weight of leaves was noticed when soaked bulbs in different concentrations of GA_3 primer, the highest dry weight (1.91 and 1.93 g) were showed for bulbs soaked in 200 and 400 mg L^{-1} respectively whereas the lowest weight (1.70 g) was for control treatment. Tryptophan had a major effect on the leaves dry weight, particularly at a concentration of 300 mg L^{-1}, which produced the highest significant dry weight of the leaves when compared to other concentrations. There was a notable difference in the triple interaction, when Blushing Apeldoorn cv. was sprayed with 300 mg L^{-1} of tryptophan and not soaked in GA_3, the highest leaf dry weight (2.36 g) was achieved.

Table (3). Effect of GA_3 primer, amino acid (tryptophan) concentrations on Dry weight of leaves (g) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	1.64 gh	1.91 d-f	2.13 b	1.87 a	
	200	1.74 fg	1.60 gh	1.75 fg		
	400	1.85 ef	2.07 b-d	2.11 bc		
Blushing Apeldoorn	0	1.77 fg	1.77 fg	2.36 a	1.82 a	1.70 b
	200	1.60 gh	1.71 fg	1.79 fg		1.91 a
	400	1.90 d-f	1.51 h	2.04 b-e		1.93 a
Tryptophan conc. Mean		1.75 b	1.76 b	2.03 a		

4- Date to flower opening stage (days)

The results of the statistical analysis in Table (4) demonstrated that the two tulip cultivars flowering times differed

significantly. Blushing Apeldoorn cultivar flowered earlier in the time required for full blooming (148.38 days) and significantly compared to the Apeldoorn cultivar (148.69 days, the soaking bulbs in 400 mg L^{-1} of GA_3 resulted in a notable improvement in the time needed for the bloom to fully open, which happened after 147.29 days. According to tryptophan results, spraying plants did not significantly reduce the amount of time needed for the bloom to open. Finally, it can be said that the soaking Blushing Apeldoorn in 400 mg L^{-1} of GA_3 and spraying with 300 mg L^{-1} of The shortest duration was observed by tryptophan, for the complete opening of the flower after (146.23 days) compared to (151.20 days) for Apeldoorn bulbs soaked in 200 mg L^{-1} of GA_3 without spayed plants with tryptophan.

Table (4). Effect of GA_3 primer, amino acid (tryptophan) concentrations on date to flower opening (days) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	149.67 ab	148.43 ab	149.93 ab	148.69 a	149.22 a
	200	151.20 a	149.33 ab	147.00 b		149.09 a
	400	146.87 b	147.37 b	148.43 ab		147.29 b
Blushing Apeldoorn	0	148.97 ab	148.33 ab	149.98 ab	148.38 b	
	200	149.58 ab	148.80 ab	148.63 ab		
	400	148.35 ab	146.50 b	146.23 b		
Tryptophan conc. mean		149.11 a	148.13 a	148.37 a		

5- Flower stalk length (cm)

The statistical analysis results in Table (5) indicated that the two tulip cultivars did not differ significantly in flower stem length. Regarding the GA_3 primer, the soaking bulbs in 400 mg L^{-1} observed that, in comparison to other concentrations, the flower stem length (8.11 cm) had the highest significant value. Tryptophan spraying had no discernible effect on the floral stalk's length. The length of the flower stem was shown to be considerably impacted by the triple interaction among the three elements under examination.; the non-soaked bulbs of the Apeldoorn cultivar in GA_3 and sprayed with 300 mg L^{-1} of tryptophan had the longest stalk (8.77 cm), while the cultivar soaked in 200 mg L^{-1} of GA_3 and sprayed with 300 mg L^{-1} had the shortest stalk (5.87 cm).

6- vase life of flower life (day)

The outcomes Table (6) made it clear that the vase life of the two tulip flower varieties did not differ significantly. The vase life of flowers affected significantly by used different concentrations of GA_3, the soaking bulbs in 200 mg L^{-1} caused increased in life of cut flowers to (6.56 days) while the least life (5.72 days) was for high concentration of GA_3 (400 mg L^{-1}). According to the table data, plants sprayed with 150 and 300 mg L^{-1} of tryptophan had the greatest values, lasting 6.11 days as opposed to 5.94 days for the control plants. The vase life of cut flowers was significantly impacted by the triple interaction between cultivars, GA_3, and tryptophan. However, the Blushing Apeldoorn recorded a shorter vase life (5.00 days) when soaked bulbs in 400 mg L^{-1} of GA_3 and sprayed plants with 300 mg L^{-1} of tryptophan. The control treatment for Apeldoorn cv. flowers had a longer vase life (7.33 days).

Table (5). Effect of GA_3 primer, amino acid (tryptophan) concentrations on flower stalk length (cm) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	7.54 a-d	7.17 a-d	8.77 a	7.64 a	7.43 b
	200	7.27 a-d	7.77 a-c	5.87 d		7.09 b
	400	8.30 ab	7.79 a-c	8.33 ab		8.11 a
Blushing Apeldoorn	0	7.03 a-c	7.90 a-c	6.17 cd	7.45 a	
	200	6.69 b-d	8.07 ab	6.91 a-d		
	400	8.27 ab	7.63 a-d	8.37 ab		
Tryptophan conc. mean		7.52 a	7.72 a	7.40		

7- Bulbs size (cm^3)

Table (7) revealed a considerable impact on bulb size, with Blushing Apeldoorn having the largest bulbs (8.11 cm^3) and Apeldoorn having the smallest (7,70 cm^3). According to the table data, plants that were not soaked with GA_3 concentration had the greatest meaningful values (8.36 cm^3) compared to those that were soaked with the 200 and 400 mg L^- (7.81 and 7.55 cm^3). The bulb size was significantly impacted by the triple interaction among the three factors under investigation. The highest significant values, reaching (13.27 cm^3), were obtained by unshaking Blushing Apeldoorn bulbs in GA_3 and spraying plants with 300 mg L^{-1} of tryptophan. This was in contrast to (4.70 cm^3) obtained by soaking Apeldoorn bulbs in 400 mg L^{-1} of GA_3 and spraying plants with 300 mg L^{-1} of tryptophan.

Table (6). Effect of GA_3 primer, amino acid (tryptophan) concentrations on vase life of flower life (days) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	7.33 a	6.67 a-c	6.33 a-d	6.19 a	
	200	5.67 b-d	6.00 a-d	6.00 a-d		
	400	5.33 cd	6.33 a-d	6.00 a-d		
Blushing Apeldoorn	0	5.67 b-d	6.33 a-d	7.00 ab	5.93 a	5.89 b
	200	5.67 b-d	5.67 b-d	6.33 a-d		6.56 a
	400	6.00 a-d	5.67 b-d	5.00 d		5.72 b
Tryptophan conc. mean		5.94 a	6.11 a	6.11 a		

Table (7). Effect of GA_3 primer, amino acid (tryptophan) concentrations on bulbs size (cm^3) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	6.37 fg	8.94 b-d	9.50 bc	7.70 b	
	200	9.93 b	7.23 ef	6.11 fg		
	400	8.53 c-e	7.97 de	4.70 h		
Blushing Apeldoorn	0	5.80 gh	6.27 fg	13.27 a	8.11 a	8.36 a
	200	8.27 e-d	8.73 b-d	6.58 fg		7.81 b
	400	5.75 gh	9.60 bc	8.73 b-d		7.55 b
Tryptophan conc. mean		7.44 b	8.12 a	8.15 a		

8- Bulblets number per plant

According to the data in Table (8) the cultivars had a substantial impact on the number of bulblets per plant; the Apeldoorn cultivar had the largest significant number of bulblets (3.26 bulbs $plant^{-1}$), while the Blushing Apeldoorn cultivar had the lowest number (2.96). Additionally, GA_3 had a substantial impact on the number of bulblets; soaking bulbs in 200 mg L^{-1} produced the most significant number of bulblets (3.39). Furthermore, the number of bulblets increased significantly (3.50 bulblets $plant^{-1}$) in plants treated with 150 mg L^{-1}. The bulblets of the Blushing Apeldoorn cultivar that were soaked in 400 mg L^{-1} of GA_3 and sprayed with 150 mg L^{-1} of tryptophan had the highest number (4.67), while the cultivar that was soaked in 200 mg L^{-1} of GA_3 and sprayed with 300 mg L^{-1} of tryptophan had the lowest number (2.00 bulblets $plant^{-1}$). The three components' interaction demonstrated that the treatments differed significantly from one another.

Table (8). Effect of GA_3 primer, amino acid (tryptophan) concentrations on bulblets number per plant of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	2.67 cd	4.33 ab	3.67 bc	3.26 a	
	200	3.00 cd	2.33 d	2.33 d		
	400	2.67 cd	2.67 cd	3.00 cd		
Blushing Apeldoorn	0	4.00 ab	3.00 cd	2.67 cd		2.89 b
	200	3.67 bc	4.00 ab	2.00 d	2.96 b	3.39 a
	400	3.00 cd	4.67 a	2.33 d		3.06 ab
Tryptophan conc. mean		3.17 a	3.50 a	2.67 b		

9-Total chlorophyll content in leaves (%)

Table (9) showed that there was no significant difference in the total chlorophyll content of the leaves between the two tulip varieties. The amount of total chlorophyll in leaves was significantly impacted by the GA_3 primer; the bulbs soaked in 200 mg L^{-1} had the greatest value, (69.39%). Tryptophan spray bulbs with 150 mg L^{-1} produced the greatest significant values, reaching (69.57%), which was substantially different from the control plants' (67.92%). The highest significant values, reaching 75.31, were obtained by spraying plants with 150 mg L-1 of Tryptophan and soaking bulbs of the Blushing Apeldoorn cv. in 200 mg L^{-1} of GA_3, according to the results of the three-way interaction of the study components. In contrast, this value decreased to its lowest (66.30%) in 400 mg L^{-1} of GA3 spraying plant with 0 mg L^{-1} of Tryptophan of Blushing Apeldoorn cultivar.

Table (9). Effect of GA_3 primer, amino acid (tryptophan) concentrations on total chlorophyll content in leaves (%) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	67.75 bc	69.16 bc	68.40 bc	68.36 a	
	200	70.17 bc	66.93 bc	65.85 c		
	400	66.99 bc	70.41 bc	69.61bc		
Blushing Apeldoorn	0	67.43 bc	67.94 bc	70.94b		68.60 ab
	200	68.89 bc	75.31 a	69.21 bc	68.85 a	69.39 a
	400	66.30 c	67.70 bc	65.97c		67.83 b
Tryptophan conc. mean		67.92 b	69.57 a	68.33 ab		

10- Total carbohydrates content in leaves (%)

The data in Table (10) indicates that the percentage of carbohydrates in the leaves of the two tulip varieties differed significantly; the Apeldoorn cultivar had a higher proportion (6.52%) than the Blushing Apeldoorn cultivar (5.39%). Comparing bulbs soaked in 200 mg L^{-1} of GA_3 acid to other concentrations, the percentage of carbohydrates in the leaves increased dramatically to 6.49%. Meanwhile, this percentage significantly increased to (6.40%) when plants sprayed with the application 150 mg L^{-1}. The highest significant percentage of carbohydrates in the leaves, 8.20 percent, was obtained by soaking bulbs of the Apeldoorn cultivar in 200 mg L^{-1} of GA_3 and spraying 150 mg L^{-1} of tryptophan. In contrast, the control plants of the Blushing Apeldoorn cultivar had the lowest percentage of carbohydrates in their leaves, (3.80%). The triple interaction of the components under inquiry produced this result.

Table (10). Effect of GA_3 primer, amino acid (tryptophan) concentrations on total carbohydrate content in leaves (%) of two Tulip cultivars (*Tulipa sp.*).

Cultivars	GA_3 primer mg L^{-1}	Amino acid (tryptophan) conc. mg L^{-1}			Cultivars mean	GA_3 primer mean
		0	150	300		
Apeldoorn	0	7.27 bc	6.10 ef	6.50 de	6.52 a	
	200	4.63 j	8.20 a	6.93 cd		

	400	5.53 f-i	6.80 cd	6.70 cd		
Blushing Apeldoorn	0	3.80 k	5.13 ij	4.97 ij	5.39 b	5.63 b
	200	5.90 fg	7.50 b	5.80 f-h		6.49 a
	400	5.43 hi	4.67 j	5.30 hi		5.74 b
Tryptophan conc. mean		5.43 c	6.40 a	6.03 b		

It appear from the results in Tables (1, 2, 4, 7, 8 and 10) for tulip plant cultivars showed all measurements except leaf dry weight of the traits under study were significantly impacted by the cultivars includes total chlorophyll content in leaves, flower stalk length and, vase life of flowers as in Tables (3, 5, 6 and 9) which had no effect significantly, where in Tables (1, 4, 8 and 10) it was noticed that Apeldoorn cv. was significantly superior to Blushing Apeldoorn cv. in the plant height, number of day to flower opening, bubllets number and total carbohydrate content in leaves. While in Tables (2 and 7) Blushing Apeldoorn cv. was superior to Apeldoorn cv. significantly in (leave area and bulb size) the results were in agreement with [15] that ten commercial tulip varieties— Pink Diamond, Jumbo Beauty, Roi-du-mudu, Avignon, and Clear Wate, Maureen, Holland Cich, Day Dream, Pussima Design, and Apeldoorn were chosen for the study and treated as a single treatment in a field experiment. The findings showed that Avignon had the maximum flower diameter and length, while Pink Diamond had the maximum plant height and leaf length. While Roi-du-mudu recorded the earliest petal from full bloom, Pink Diamond displayed a delayed petal drop. Apeldorn recorded the most stems per plot and bulblets of any variety that was chosen. Also agree with [16] referred that the cut flowers prefer specific characteristics of the tulip plant in terms of delivery times and quality, such as plant height, flowers, and other traits that depend on the cultivar**.** Also these results constant with [17] on Hyacinth plant (*Hyacinthus orientalis* L.), and with [18] on four cultivars of *Gladiolus grandiflorus*. These may be returned because of the variations in these cultivars' genetic potentials [19].

As for effect of gibberellic acid (GA_3) premier it noticed from results in Tables (1, 2, 3, 4, 5, 6, 8, 9 and 10) that Gibberellic acid had a beneficial impact on the most traits of tulip plant except results in Tables (7) which had not any significant effect on bulb sizes, where in Tables (2, 3, and 8) it was showed that the both concentrations of GA_3 (200 and 400 mg L^{-1}) appeared a no significant with control treatment , dry weight of leaves and bulblets number, while the results in Tables (6, 9, and 10) showed GA_3 had a major impact on flower vase life, leaf total chlorophyll content, and leaf total carbohydrate content at a concentration of 200 mg L^{-1}, on the other hand the results in Tables (1, and 5) stated that the height of the plants and the length of the flower stalks were significantly impacted by GA_3 at a dosage of 400 mg L^{-1}. These results align with those of [20], who examined the effects of three plant regulators, including gibberellic acid, on *Tulipa gesneriana* growth, flowering, and bulb production, the bulbs were soaked for an hour at concentrations of 100, 200, and 400 mg L^{-1}, the highest plant height was achieved when the plants were treated with 400 mg L^{-1}, followed by 200 mg L^{-1}, the 400 mg L^{-1} concentration also caused early flowering, and the longest flowering period was observed when the plants were treated with concentration 200 mg L^{-1}. However, the dose of 200 mg L^{-1} produced the longest flowering life, whereas the concentration of 400 mg L^{-1} produced the greatest number of bulbs and bulblets. In their investigation into the effects of soaking bulbs with GA_3 at varying concentrations (0, 100, and 200 ml L^{-1}) on vegetative growth, flowering traits, and bulbs yield for two cultivars of *Tulip sp.* L. bulbs, [21] demonstrated that the highest values in every attribute under investigation were recorded as a result of the soaking treatment with gibberellic acid at a concentration of 200 mg L^{-1}, the higher internal gibberellin concentration, which stimulates active cell division and cell elongation in the apical meristem to promote vegetative development, is responsible for the beneficial effects of gibberellin on vegetative growth features [22]. Gibberellins' impact on the activity of the photosynthesis process, which raises the plants' efficiency in using the byproducts of photosynthesis, is another potential explanation for the notable increase in plant height. Alternatively, this may be explained by the rise in cell elongation and division, which leads to more cells and longer cells, which in turn impacts plant development and leaf area. Another explanation would be because gibberellin stimulates enzymes that weaken cell walls, which results in cell elongation. Gibberellin's mechanism of stimulating cell elongation also involves the hydrolysis of starch through the stimulation of the α-amylase enzyme, which may raise the concentration of sugars and, in turn, the osmotic pressure in the cell sap, allowing water to enter the cell and causing it to elongate. The other reason could be related to gibberellin's ability to increase the efficiency of photosynthesis processes by expanding and promoting healthy vegetative growth, which resulted in the buildup of nutrients in storage areas and an increase in the amount of chlorophyll and carbohydrates in different plant parts. [23]**.**The reason may also be attributed soaking in gibberellin increased the carbohydrate content, leading to earlier flowering. The other possible reason for the increased flowering may be attributed to the presence of GA_3 in optimal amounts under the conditions of these treatments, which caused the elongation of the floral stalk and the flower. As for improving the flowering duration of cut flowers, the reason may be attributed to the behavior of gibberellin in maintaining the freshness of the florets and extending their flowering

duration. This is due to its role in activating a large number of enzymes and some of them being involved in the synthesis of nucleic acids such as DNA and RNA, which are important in the metabolism of carbohydrates and proteins. Some of these are involved in the composition of cell membranes, maintaining their permeability and various functions. This positively reflects on improving the floral traits represented by the length of the floral stalk, and the duration of their flowering, which are important characteristics for commercially cut flowers. Additionally, their content of stored nutrients helps them stay in vases longer [24]**.** The positive effect of gibberellic acid in enhancing flowering growth traits is due to increased photosynthesis and CO_2 fixation. Additionally, gibberellin encourages factors influencing flower formation, such as the carbohydrate pathway, photoperiod pathway, and GA_3 pathway. The significant effect of bulblets number may be attributed to the nutritional balance among the elements that prepared the plant to receive and process the nutrients. This is reflected in the increased traits bulblets.

The results of spray tryptophan in Tables (2, 3, 7, 8, 9 and 10) had a major impact on most tulip plant characteristics, including leaf area and dry weight, bulb size, number of bulblets, total chlorophyll content, and total carbohydrate content, with the exception of plant height and blooming features, which were not dramatically impacted. These findings are consistent with [25] about the same plant and the same quantity of 300 mg L^{-1}, as well as the results [26] acquired regarding the impact of tryptophan spraying on the rocket plant *Erauca sativa*. Apart from the outcomes of [27] regarding the superiority of tryptophan at a concentration of 150 mg L^{-1} in *Gerbera jamesonii* early flowering and leaf chlorophyll content, as well as the fact that tryptophan foliar spraying promotes auxin synthesis within the plant and heightens agricultural crop growth and productivity. Additionally, these findings align with the research [28] the effects of spraying tryptophan at concentrations of 0, 150, 250, and 350 mg L-1 on the lemon grass *Cymbopogon citratus* plant physiological traits, oil yield, and qualitative traits were confirmed in a study. The results also showed that spraying tryptophan at a concentration of 350 mg L^{-1} was superior to the comparison treatment in terms of increasing growth characteristics (plant height, number of developing buds, fresh and dry weight of the plant), and that it had a significant impact on the chlorophyll content of the leaves and plant dry weight when compared to the comparison treatment. As well as chemical characteristics, total carbohydrates to the pigments of the control treatment plants of *Urtica pillifera* plant. Similar results were reached by [29] the average number of leaves, plant height, leaf area, and diameter of the new corm formed all increased significantly when gladiolus varieties were sprayed with different amounts of the tryptophan amino acid. However, in terms of enhancing growth features, flowers, and corm output, the concentration of 300 mg L^{-1} performed noticeably better than the concentration. Since the amino acid tryptophan is the first precursor of the plant hormone auxin, which plays a crucial role in controlling plant growth and development, it played an effective role in improving the majority of vegetative growth, bulb size, and bulblet number [14]. Since this amino acid is building block of auxin biosynthesis, In plant tissues, its inclusion results in a rise in auxin production (IAA). Numerous researchers have confirmed that tryptophan, an amino acid, increases the products of photosynthesis and the level of amino and nucleic acids. This finding suggests that an increase in plant hormones has a positive impact on improving most characteristics by increasing cell size, elongation, and division processes, and the synthesis of necessary proteins that promote cell growth and division. Additionally, it plays a part in boosting the activity of numerous enzymes, particularly those that create and shape the chlorophyll molecule, which in turn increases the plant's capacity for photosynthetic activity and, consequently, the amount of chlorophyll in its leaves [30]**.** Tryptophan, an amino acid, can be sprayed foliar to promote auxin synthesis within plants, which enhances crop growth and yield**.**

Triple interactions between the factors under study and their outcomes in Tables (1, 2, 3, 4, 6, 7, 8 and 9) indicated that soaking bulbs of Blushing Apeldoorn cultivar in different concentrations of GA_3 and spray with different concentrations of tryptophan led to obtain significant highest values of the most traits of tulip plant except date to flowers opening and total carbohydrates as in Tables (5 and 10) shows significant values when treatment Apeldoorn cultivar with GA_3 and tryptophan.

Conclusions

This research concluded that the Cultivars of tulip plants significantly impacted the majority of the traits under study. Apeldoorn cv. was a substantial improvement over Blushing Apeldoorn cv. in the plant height, date to flower opening, bubllets number and total carbohydrate content in leaves, while Blushing Apeldoorn cultivar was superior significantly to Apeldoorn cv. in leave area and bulb size. Gibberellic acid at concentration 200 and 400 mg L^{-1} had a positive Influence on the majority of tulip plant characteristics in bulb sizes. Spray tryptophan at concentration 150 and 300 mg L^{-1} also had a significant impact on some characteristics of tulip includes leaf area, leaves dry weight, bulb size, bulblets number, total chlorophyll content and total carbohydrates content except plant height and flowering traits which no effect significantly.

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تاثير النقع بحامض الحبرليك والرش الورقي بالحامض الامينى (تربتوفان) في النمو الخضري والتزهير وانتاج الابصال والبصيلات لصنفين من نبات التيولب (*Tulipa gesneriana* L.)

يوسف علي عبدالرحمن [1] نيزيك مصلح انور [1]

قسم البستنة، كلية علوم الهندسة الزراعية، جامعة دهوك، دهوك، العراق.

الخلاصة

اجري الدراسة في الظلة الخشبية التابعة لقسم الغابات – كلية علوم الهندسة الزراعية – جامعة دهوك – دهوك – العراق للفترة من 25 تشرين الاول 2024 ولغاية 1 حزيران 2025. تهدف الدراسة استجابة ابصال صنفين من نبات التيولب (***Apeldoorn*** و ***Blushing Apeldoorn***) للنقع في تراكيز مختلفة من حامض الجبرليك (0 ، 200 و 400 ملغم لتر $^{-1}$) لمدة 24 ساعة والرش بالحامض الاميني (تربتوفان وبثلاث تراكيز (0 ، 150 و 300 ملغم لتر $^{-1}$) كل 30 يوما حتى التزهير. اجريت الدراسة باستخدام تصميم القطاعات العشوائية الكاملة (***RCBD***) وبثلاث مكررات كل كرر تحوي 6 سنلدين وكل سندانة بقطر 17 ملم زرعت ببصلة واحدة. وقورنت المتوسطات باستخدام اختبار دنكن متعدد الحدود تحت مستوى احتمال 5%. وبينت النتائج بان الصنف ***Apeldoorn*** قد تفوق معنويا على الصنف ***Blushing Apeldoorn*** في ارتفاع النبات (18.63 سم) ، عدد البصيلات (3.26) ومحتوى الكاربوهيدرات الكلية في الاوراق (6.25%) ، بينما الصنف ***Blushing Apeldoorn*** قد تفوق معنويا في المساحة الورقية (60.11 سم^2) ، عدد الايام للتزهير (148.38 ايام) وحجم الابصال (8.11 سم^3). ولوحظت تاثير معنوي لكلا التركيزين 200 و400 ملغم لتر$^{-1}$ من حامض الجبرليك في الوزن الجاف للمجموع الخضري (1.91 و 1.93 غم) و عدد البصيلات (3.39 و 3.06) على التوالي ، بينما التركيز 200 ملغم لتر$^{-1}$ من حامض الجبرليك اثر معنويا في العمر المزهري (6.56 يوم) ، محتوى الكلوروفيل الكلي قي الاوراق (69.39%) والنسبة للكاربوهيدرات في الاوراق(6.49%) ومن جهة اخرى حامض الجبرليك عند الركيز 400 ملغم لتر$^{-1}$ كان لها تاثير معنوي في ارتفاع النبات (19.73 سم)، وطول ساق الزهري (8.11 سم). كما كان لرش التربتوفان تأثير معنوي على بعض صفات نبات التوليب تشمل المساحة الورقية (61.72 سم^2)، عدد البصيلات (3.50)، محتوى الكربوهيدرات الكلية (6.40٪)، محتوى الكلوروفيل الكلي (69.57٪) ومحتوى الكربوهيدرات الكلية (6.40٪)اقد اثرت معنويا بتركيز 150 ملغم لتر$^{-1}$ ولكن لوزن الجاف للأوراق (2.03 غم)، حجم الأبصال (8.15 سم^3)، عدد الأبصال (3.50) قد اثرت بالتركيز 300 ملغم لتر$^{-1}$.

الكلمات المفتاحية: اصناف نبات التيوليب ، حامض الجبرليك ، الحامض الاميني (تربتوفان) .