The Effect of Gibberellic Acid GA_3 and Benzyl Adenine BA on the Growth of Vitis Vinifera Halawani Seedlings and Their Content of Some Nutrients

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ABSTRACT

The research was carried out in the wood canopy at the research station B of the Department of Horticulture and Landscape Gardening - College of Agricultural Engineering Sciences - the University of Baghdad for the seasons 2018-2019. The aim of this study was to investigate the effect of gibberellic acid (GA_3) and benzyl adenine (BA) and their interactions on the growth of Halawani grape seedlings and their content of some nutrients. The study included 12 treatments that are three levels of gibberellic acid with the addition of (0, 50, 100, 150 mg/L) with two concentrations of benzyl adenine without addition, it is (0, 100, 150 mg/L.). It was carried out as a factorial experiment according to the randomized completely block design with three replicates. The results showed that gibberellic acid at the level of 50 mg/L gave the highest stem length and root dry weight for both seasons. Besides, the highest percentage of carbohydrates and nitrogen in the branch and the leaf content of nitrogen and phosphorous in the second season. Accordingly, Benzyl adenine at the level of 100 mg/L recorded the highest stem length, root dry weight, carbohydrate and nitrogen percentage in the branches and the highest leaf content of nitrogen and zinc. The interaction of the study factors had a significant effect on all the studied traits.

Keywords: Gibberellic Acid GA3, Benzyl Adenine BA, Vitis Vinifera Halawani

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INTRODUCTION

The grape Vitis vinifera L. belongs to the family Vitaceae, where the most important of which is the genus vitis (Leavitt and Munnecke, 1987). The variety Halawani from the luxury table grapes in agricultural production and is one of the delays maturing varieties and occupies an important place in the Iraqi markets. Many studies indicated that the growth regulators are of great importance in plant life, as the growth and development processes are under the control of hormones produced inside the plant itself. However, many of the manufactured compounds have efficacy similar to the effectiveness of hormones and have become used in agriculture and for many purposes. Besides, the use of commercial growth regulators in agriculture for industrially and agricultural developed countries contributed to the development of agriculture significantly. Gibberellin regulates the transition from juvenility to maturity, stimulates stem elongation in stunted plants and plants with closely spaced leaves, and stimulates flowers (Hedden and Stephen, 2006). There are no synthetic gibberellins as in the case of Auxins and Cytokines, as gibberellins are produced on a commercial scale from mushroom farms Gibbrella sp. In general, GA_3 is the most widely produced and used in agricultural research (AL-Asasdy and AL-Kikhani, 2019). Cytokinins are plant hormones that are naturally produced in plants and regulate the work of plant cells, including stimulating and regulating cell division. Furthermore, it has other physiological effects including, the movement and transport of nutrients, the activity of apical meristem, differentiation and development of chloroplast with increased accumulation of chlorophyll in them, inhibition of apical dominance, and aging (Taiz and Zeiger, 2010). Despite the fact that Benzyl Adenine BA is one of the most commonly used cytokine compounds in agricultural studies and research.

MATERIALS AND METHODS

The study was carried out in the wood canopy of the Department of Horticulture and Landscape Gardening at the Research Station B of the college of Agricultural Engineering Sciences / University of Baghdad / Al-Jadriya, for the seasons 2018 and 2019. Anywhere, the cuttings were taken in mid-February in both seasons, from a one-year-old canes with a length of 30 containing three eyes. These cuttings were cut by a flat cut at the bottom of the node area, and from the top as an oblique cut above the node by 3 cm. Subsequently, the cuttings were transplanted into plastic bags containing a medium of peat moss, so that one bud appeared from the cuttings. Finally, seedlings with the most uniform growth were selected with two seedlings for each experimental unit, then service operations were carried out from fertilization, irrigation, and control of insect and fungal diseases (Jasim, 2012).

- ***Treatments***

The experiment included two factors, the first factor represents four levels of gibberellic acid (GA_3) (0, 50, 100, and 150 mg/L) symbolized with (GA0, GA50, GA100, and GA150) were used respectively. The second factor is the use of three levels of Benzyladenin (BA) with concentrations of (0, 100, and 150) mg/L symbolized with (BA0, BA50, BA100) respectively. On the other hand, the spraying date was after the seedlings formed from four to five fully grown leaves with GA_3, and after 3 days BA was sprayed on each date by two sprays, between one spray and another 30 days.

- ***Experimental design***

The treatments were distributed randomly as a factorial experiment (3 x 4) according to the Randomized Complete Block Design (R.C.B.D.), with three replicates and by two seedlings for each experimental unit. The differences between the averages were compared according to the least significant difference LSD test under the probability level of 0.05 using the commercial Genstat program to analyze the results.

Studied traits.

1- Stem length (cm)

The length of the main stem was measured, from the growing area on the node to the end of the stem tip, using a metric tape measure on December 1 of each season.

2- Root dry weight (g)

The plants were removed from the agricultural medium, and the washing process was performed with running water. Further, the root was separated from the shoot and dried in an electric oven at a temperature of 70 ℃ until the weight is constant, then each of them weighed individually with a sensitive scale.

3- The carbohydrates percentage in the branches (%)

Joslyn's (1970) method was used to estimate the percentage of total carbohydrates in the branches. Samples were taken from the branches on December 1 for both seasons 2018 and 2019, and they were dried until the weight constant, then milled and 0.2 g of it were taken and placed in a test tube and Perchloric acid solution (1N) was added to it. The samples were placed in a water bath for 60 minutes with repeating this process three times, and each time, centrifugation was conducted for 15 minutes at a speed of 3000 rpm. Consequently, the supernatant solution was collected in a volumetric flask and continued to 100 ml by adding distilled water. Then 1 ml of the diluted solution was taken, and 1 ml of a 5% phenol solution and 5 ml of concentrated sulfuric acid were added to it. Then the absorbance of the solutions was read by the spectrophotometer at a wavelength of 490 nm. then the readings were projected onto the standard curve. Also, the carbohydrate percentage was recorded according to the equation below: Carbohydrates = concentration x dilution x 100

1000 x hope x sample weight

$$\text{Carbohydrates} = \frac{\text{concentration x dilution}}{\text{1000 x 1ml x sample weight}} \times 100$$

4- ***Nitrogen percentage in branches (%)***

A 0.5 g of the milled sample taken from the branches (carbohydrate sample) was weighed and digested with sulfuric and perchloric acid and then estimated according to the (Jackson, 1958) method.

5- Carbohydrate to nitrogen C / N ratio in the branches

Depending on the results of percentage of carbohydrates and the percentage of nitrogen with the following equation:

$$C\ /\ N = \frac{\text{percentage of carbohydrates}}{\text{percentage of nitrogen}}$$

6- Leaf content of Fe, Zn, Mg, N, P, K.

The leaves for each experimental unit were taken from different directions of the seedlings (the fifth leaf below the growing point) on June 15 for the seasons 2018 and 2019 and dried in an electric oven at 65 ° C until the weight is constant, these leaves were crushed, and 0.2 g of the crushed sample was taking, and digested by adding 4 ml of concentrated sulfuric acid and 2 ml of concentrated perchloric acid (Jones and Steyn, 1973). The previously mentioned elements were estimated as follows: Nitrogen was estimated (%) using the (Micro Kjeldahl) device according to the method mentioned in (Jackson, 1985). Phosphorous, potassium, iron, zinc, and magnesium (%) was estimated using a Spectrophotometer according to the method mentioned in (Page 1982).

RESULTS AND DISCUSSION

- ***Stem length (cm)***

The results of Table 1 showed that the treatment GA50 led to a significant increase in plant height, for both seasons (187.04 and 163.74) cm respectively. This treatment significantly exceeded the two treatments GA100 and GA150 in both seasons, whose height in the first season reached (178.04, 184.04) cm. respectively, and in the second season reached (156.86, 162.92) cm, respectively. In the role of for the effect of benzyl adenine, the Table showed that there was a significant increase in this trait, as the treatment BA100 recorded the highest plant height of 187.03 cm in the first season after it was 180.51 cm in the comparison treatment. Then, 164.92 cm in the second season after it was 160.16 cm in the comparison treatment. The interaction treatments between gibberellic acid and benzyl adenine had a significant effect, as the treatment GA50.BA100 exceeded in the height for the first season and recorded 198.85 cm. However, the treatment GA0.BA0 was the shortest by 131.88 cm, while the treatment GA50.BA50 was significantly superior in the second season and recorded 172.92 cm, after it was 107.60 cm in the GA0.BA0 treatment.

Table 1. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the stem length of Halawani variety grape seedlings (cm) for the seasons 2018 and 2019

	Season 2018					Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	131.88	167.26	168.78	180.51	162.11	107.60	142.96	146.32	160.16	139.26
BA50	172.09	195.02	179.21	192.40	184.68	149.36	172.94	157.34	169.46	162.27
BA100	180.14	198.85	187.85	181.29	187.03	156.64	175.33	166.92	159.13	164.76
Mean	161.37	187.04	178.61	184.73		138.20	163.74	156.86	162.92	
L.S.D. (0.05)	GA_3=2.872 BA=2.487 GA_3*BA=4.974					GA3=2.551 BA=2.209 GA3*BA=4.418				

- ***Root dry weight (g)***

The results of Table 2 indicated that the treatment of spraying with gibberellic acid at the GA50 level was significantly superior in the root dry weight in both seasons. This treatment reached 31.618 g in the first season, after it was 27.279 g in the comparison treatment, and 27.679 g in the second season compared to the comparison treatment, which recorded 23.344 g. The same table showed that there are significant differences in the root dry weight as a result of treatment with benzyl adenine, as the treatment BA100 recorded the highest root dry weight, which was 30.618 g in the first season, Also, its achieved 27.851 g in the second season, after the root dry weight was at the level of comparison treatment is 30.513g in the first season, and 23.526g in the second season. The interaction between gibberellic acid and benzyl adenine showed the highest root dry weight at treatment GA50.BA100 in both seasons by (33.617 and 29.637) g, respectively. This interaction treatment significantly exceeded the comparison treatment in both seasons, which recorded 22.293 g in the first season, and 18.137 g in the second season.

Table 2. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the root dry weight of Halawani variety grape seedlings (g) for the seasons 2018 and 2019

	Season 2018					Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	22.293	28.273	28.530	30.513	27.403	18.137	24.167	24.730	27.070	23.526
BA50	29.090	32.963	30.293	32.520	31.217	25.250	29.233	26.593	28.640	27.429
BA100	30.453	33.617	31.753	30.647	31.618	26.647	29.637	28.220	26.900	27.851
Mean	27.279	31.618	30.192	31.227		23.344	27.679	26.514	27.537	
L.S.D. (0.05)	GA_3=0.4855 BA=0.4205 GA_3*BA=0.8410					GA3=0.4306 BA=0.3729 GA3*BA=0.7458				

- ***The carbohydrates percentage in the branches (%)***

It was noticed from Table 3 that there are significant differences in this characteristic once treating plants with gibberellic acid, as the treatment GA100 gave the highest percentage of carbohydrates in the first season, which was 36.832. This treatment exceeded both of the GA0 treatment, which recorded the lowest percentage of 33.522%, and the GA50 and GA150 treatments of (34.502), (34.917) %. However, the GA50 treatment in the second season recorded the highest percentage of carbohydrates, which amounted to 38.240%, which was significantly superior to the rest of the treatments, after the comparison treatment recorded the lowest percentage of 32.250%. As for the effect of spraying with benzyl adenine, the treatment BA100 exceeded and gave the highest percentage of carbohydrates in both seasons, which was (36.608 and 38.480 %) respectively, with a significant difference from the rest of the treatments and in both seasons. The response was significant to the interaction between gibberellic acid and benzyl adenine, as the treatment GA100.BA100 gave the highest percentage of carbohydrates in the first season reached 41.097%, while the lowest percentage of carbohydrates was 30.800% at treatment GA0.BA0. Moreover, the treatment GA50.BA100 in the second season recorded the highest percentage of carbohydrates amounted to 40.950% and the lowest percentage at the comparison treatment that amounted to 25.050%.

Table 3. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the percentage of carbohydrates in branches of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

	Season 2018					Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	30.800	32.600	36.403	36.397	34.050	25.050	33.390	34.170	37.400	32.500
BA50	36.197	32.303	32.997	35.190	34.172	34.880	40.390	36.750	39.580	37.900
BA100	33.570	38.603	41.097	33.163	36.608	36.810	40.950	38.990	37.170	38.480
Mean	33.522	34.502	36.832	34.917		32.250	38.240	36.640	38.050	
L.S.D. (0.05)	GA_3=0.4515 BA=0.3910 GA_3*BA=0.7820					GA3=0.595 BA=0.516 GA3*BA=1.031				

- ***Nitrogen percentage in branches (%)***

The results of Table 4 indicated that gibberellic acid did not have a significant effect on the nitrogen percentage of the branches in the first season, compared to the control treatment, which recorded the highest nitrogen percentage of 1.511%, while GA100 recorded the lowest percentage, which reached 1.313%. However, the treatment GA50 in the second season recorded the highest percentage of nitrogen in the branches reached 1.6524%, which did not differ significantly from the treatment GA150, which recorded 1.6446%, after the comparison treatment recorded the lowest nitrogen percentage of 1.3939%. The same Table explained that there are significant differences between the benzyl adenine treatments, as the treatment BA100 gave the highest percentage of nitrogen in the branches in both seasons reached (1.559 and 1.667)% respectively, after the comparison treatment was recorded in the first season 1.036% and in the second season 1.4055%. The treatment GA0.BA100 significantly exceeded the interaction between gibberellic acid and benzyl adenine, as it gave the highest nitrogen percentage in the first season, which was 1.766%, compared to GA0.BA0, which gave 1.333%, while the lowest nitrogen percentage was (0.701%) at treatment GA150.BA0. Whereas in the second season, the treatment GA50.BA100 recorded the highest nitrogen percentage reached 1.7710%, compared to the treatment GA0.BA0, which gave the lowest percentage was 1.0837%.

Table 4. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the nitrogen percentage in branches of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

Season 2018						Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	1.333	1.054	1.055	0.701	1.036	1.0837	1.4437	1.4773	1.6173	1.4055
BA50	1.433	1.444	1.334	1.334	1.386	1.5060	1.7427	1.5820	1.7117	1.6356
BA100	1.766	1.444	1.550	1.477	1.559	1.5920	1.7710	1.6817	1.6047	1.6623
Mean	1.511	1.314	1.313	1.170		1.3939	1.6524	1.5803	1.6446	
L.S.D. (0.05)	GA_3=0.1101 BA=0.0954 GA_3*BA=0.1908					GA3=0.02511 BA=0.02175 GA3*BA=0.04350				

The ratio of carbohydrate to nitrogen in the branch's C / N ratio

The results of Table 5 indicated that the treatment GA150 was significantly superior in this characteristic in the first season and reached 33.69 compared to the comparison treatment, which amounted to 22.75, which was significantly lower than the two treatments GA100 and GA50 (28.51, 26.81) respectively. Although the treatment GA100 was the highest rate of 23.1795, it did not significantly superior the rest of the treatments for the second season. Similarly, the same Table showed that there was a decrease in this trait with an increase in the concentration of benzyl adenine in the first season, where the comparison treatment recorded the highest rate in this characteristic of 35.17, while BA100 recorded the lowest rate of 23.78. In the second season, no significant differences were also recorded, as the treatment BA50 gave the highest average of 23.1710, which did not differ significantly from the treatment BA0 and BA100 (23.1260, 23.1469) respectively. Finally, the treatment GA150.BA0 exceeded in the first season and recorded 52.00, while the treatment GA0.BA0 recorded the lowest rate of 23.26. Likewise, there were no significant differences between the treatments, as the treatment GA100.BA50 recorded the highest rate reached 23.2253, while the treatment GA0.BA0 recorded the lowest rate, which was 23.1181 for the second season.

Table 5. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the ratio of carbohydrate to nitrogen in the branch's C / N ratio of Halawani variety grape seedlings for the seasons 2018 and 2019

Season 2018						Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	23.26	30.92	34.50	52.00	35.17	23.1181	23.1277	23.1315	23.1267	23.1260
BA50	25.48	22.48	24.98	26.53	24.87	23.1612	23.1763	23.2253	23.1214	23.1710
BA100	19.50	27.04	26.04	22.55	23.78	23.1250	23.1209	23.1816	23.1600	23.1469
Mean	22.75	26.81	28.51	33.69		23.1348	23.1416	23.1795	23.1360	
L.S.D. (0.05)	GA_3=2.066 BA=1.789 GA_3*BA=3.578					GA3=0.05273 BA=0.04567 GA3*BA=0.09133				

- ***Leaf content of N%***

Table 6 showed that gibberellic acid led to a significant decrease in the nitrogen content of the leaves in the first season, as the treatment GA0 gave the highest nitrogen content in the leaves of 2.766%. This treatment did not differ significantly from the treatment GA100, which gave 2.722% and was superior to the two treatments GA150, GA50, which amounted to (2.629, 2.534) %. In the second season, the treatment GA50 recorded the highest percentage of nitrogen in the leaves, which amounted to 2.8310%, which did not differ significantly from the treatment GA150, which recorded 2.8111%. On the other hand, the GA0 treatment gave the lowest percentage of nitrogen in the leaves reached 2.3861%. It was noted from the same Table that the treatment of plants with benzyl adenine led to a significant increase in this trait with an increase in the concentration of benzyl adenine. Likewise, the treatment BA100 gave the highest percentage of nitrogen in the leaves in both seasons (2.888 and 2.8422) % respectively, which was significantly superior over treatment BA50 in both seasons (2.628 and 2.8039) %, respectively. However, the control treatment in both seasons gave the lowest percentage of (2.472 and 2.4062)%. The interaction had a significant effect in this characteristic, as the treatment GA0.BA100 gave the highest percentage in the first season reached 3.153%, significantly superior to the comparison, which recorded 2.279%. In the second season, the interaction treatment GA50.BA100 recorded the highest percentage of 3.0293%, with a significant difference compared to the GA0.BA0 treatment, which recorded 1.8537%.

Table 6. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the Leaf content of N% of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

	Season 2018					Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	2.279	2.453	2.633	2.523	2.472	1.8537	2.4753	2.5280	2.7677	2.4062
BA50	2.866	2.283	2.801	2.563	2.628	2.5807	2.9883	2.7187	2.9280	2.8039
BA100	3.153	2.866	2.733	2.802	2.888	2.7240	3.0293	2.8780	2.7377	2.8422
Mean	2.766	2.534	2.722	2.629		2.3861	2.8310	2.7082	2.8111	
L.S.D. (0.05)	GA_3=0.1299 BA=0.1125 GA_3*BA=0.2250					GA3=0.04342 BA=0.03760 GA3*BA=0.07521				

- ***Leaf content of P%***

Table 7 showed that spraying plants with gibberellic acid affected this trait negatively in the first season, as this trait was recorded 0.15722% at treatment GA150, which did not differ significantly from treatment GA100 that amounted to 0.15622%. Treatment GA100 differed significantly from treatment GA50 that recorded the lowest percentage of phosphorus was 0.13767%, while the control treatment gave the highest percentage of phosphorus, which reached 0.15800%. However, the treatment GA50 recorded the highest percentage of phosphorus, which amounted to 0.18167%, with a significant difference from the treatment GA150 and GA100, which recorded (0.17411, and 0.16800)% respectively. On the other hand, the comparison treatment recorded the lowest percentage of phosphorous amounted to 0.15356%. It was observed from the same Table that there is a significant effect when spraying plants with benzyl adenine on the leaves content from the percentage of phosphorous. The spraying with benzyl adenine negatively affected this characteristic in the first season, where the comparison treatment recorded the highest percentage of phosphorus in the leaves of 0.15917%, significantly superior to the two treatment of AB100 and AB50 (0.15342, 0.14425)%.In the second season, the treatment BA100 gave the highest percentage of phosphorous, which amounted to 0.18275%, which did not differ significantly from the treatment BA50, which recorded 0.18050%, after the comparison treatment recorded 0.14475%. The treatment GA150.BA0 significantly superior at the interaction between gibberellic acid and benzyl adenine in the first season, and it gave the highest percentage of phosphorous, which reached 0.17300%, compared to the comparison treatment, which recorded 0.14600%. Although, the treatment GA50.BA50 recorded the lowest percentage of phosphorous by 0.10567%, treatment GA50.BA50 recorded the highest percentage of phosphorous, which amounted to 0.19200% in the second season, compared to the control treatment, which recorded the lowest percentage of phosphorus of 0.11867%.

Table 7. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the Leaf content of P % of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

	Season 2018					Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	

BA0	0.14600	0.15367	0.16400	0.17300	0.15917	0.11867	0.15900	0.14433	0.15700	0.14475
BA50	0.1700	0.10567	0.13967	0.16167	0.14425	0.16700	0.19200	0.17500	0.18800	0.18050
BA100	0.15800	0.15367	0.16500	0.13700	0.15342	0.17500	0.19400	0.18467	0.17733	0.18275
Mean	0.15800	0.13767	0.15622	0.15722		0.15356	0.18167	0.16800	0.17411	
L.S.D. (0.05)	GA_3=0.002773 BA=0.002401 GA_3*BA=0.004802					GA3=0.002800 BA=0.002425 GA3*BA=0.004850				

- ***Leaf content of K%***

The results of Table 8 indicated that the high concentration of gibberellic acid led to a significant increase at treatment GA150, which was recorded a percentage of potassium in leaves in both seasons reached (1.7601 and 1.5534)%, respectively. This treatment differed significantly from the rest of the treatments in both seasons, as the comparison treatment recorded 1.5378% in the first season and the GA50 treatment recorded the lowest potassium percentage amounted to 1.3999%. Similarly, in the second season, the comparison treatment recorded 1.2932%, and the GA50 treatment recorded the lowest percentage was 1.2206%. Table 8 also indicated that spraying with benzyl adenine led to a significant decrease in this trait, as the comparison treatment recorded the highest percentage of potassium in both seasons, which was (1.8641, and 1.5942)% respectively. However, the treatment BA50 recorded the lowest percentage of potassium in both seasons, which amounted to (1.4251, 1.2448)%, respectively. Whereas BA100 treatment recorded a significant superiority over the treatment BA50 in both seasons, reached (1.4423 and 1.2704)% respectively. Despite this, a significant response to increased potassium appeared in the leaves as a result of the interaction between the two factors, since the GA150.BA0 treatment recorded the highest percentage in both seasons reached (2.0433. and 1.8127)%, respectively. Further, the treatment GA50 BA50 recorded the lowest percentage of potassium in leaves in both seasons was (0.9900, and 0.8777)% respectively, after the comparison treatment in both seasons was recorded (1.9430, 1.5770)%, respectively.

Table 8. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the Leaf content of K % of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

Season 2018						Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	1.9430	1.7397	1.7303	2.0433	1.8641	1.5770	1.4880	1.4993	1.8127	1.5942
BA50	1.5203	0.9900	1.5800	1.6100	1.4251	1.2967	0.8777	1.3873	1.4177	1.2448
BA100	1.1500	1.4700	1.5197	1.6297	1.4423	1.0060	1.2960	1.3497	1.4300	1.2704
Mean	1.5378	1.3999	1.6100	1.7610		1.2932	1.2206	1.4121	1.5534	
L.S.D. (0.05)	GA_3=0.02906 BA=0.02517 GA_3*BA=0.05034					GA3=0.02123 BA=0.01838 GA3*BA=0.0367				

- ***Leaf content of Mg%***

The results of Table 9 indicated that the treatment of plants with gibberellic acid led to a significant decrease in this characteristic, as the treatment GA50 gave the lowest percentage of magnesium in leaves for both seasons it was (0.8733 and 0.7626)%, respectively. GA150 treatment was recorded in both seasons (0.9633 and 0.8499)%, respectively, while the comparison treatment recorded the highest percentage of magnesium in the first season, which reached 1.0733%, with a significant difference from all other treatments, including the GA100 treatment, which recorded 1.0301%. Whereas in the second season, the comparison treatment also recorded the highest percentage of magnesium, which amounted to 0.9125%, with a significant difference also from all other treatments except for the GA100 treatment (0.9031%). Table 9 also showed that the treatment of plants with benzyl adenine led to a significant decrease in this trait, as the treatment BA50 gave the lowest percentage of magnesium in both seasons was (0.9275, 0.8137)% respectively. Moreover, BA0 treatment recorded the highest percentage of magnesium for both seasons by (1.0851 and 0.9274)%, respectively. It was noticed that the interaction treatment GA0.BA100 recorded the highest percentage of magnesium by (1.1705 and 1.0139)% in both seasons, respectively. Finally, the treatment GA50.BA50 recorded the lowest percentage of magnesium for both seasons, it was (0.7400 and 0.6562)%, respectively.

Table 9. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the Leaf content of magnesium of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

Season 2018						Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	1.1700	0.9699	1.1705	1.0300	1.0851	0.9516	0.8291	1.0139	0.9150	0.9274
BA50	1.0900	0.7400	1.0099	0.8700	0.9275	0.9459	0.6562	0.8867	0.7659	0.8137
BA100	0.9600	0.9100	0.9100	0.9900	0.9425	0.8401	0.8024	0.8086	0.8689	0.8300
Mean	1.0733	0.8733	1.0301	0.9633		0.9125	0.7626	0.9031	0.8499	
L.S.D. (0.05)	GA_3=0.01847 BA=0.01600 GA_3*BA=0.03199					GA3=0.01537 BA=0.01332 GA3*BA=0.02663				

- ***Leaf content of Zn%***

Table 10 showed that the increase in the concentration of gibberellic acid led to a significant increase in the leaf content of zinc. Thus, the plants treated with gibberellic acid at a concentration of 150 mg/L were significantly superior in both seasons and it gave (0.0088, 0.0078)% respectively. Followed by a significant difference for the plants treated at a concentration of 100 mg/L in both seasons, which amounted to (0.0077 and 0.0068)%, respectively. This concentration was significantly superior over the plants treated at a concentration of 50 mg/L, which gave (0.0076, 0.0066)% respectively, compared to the comparison treatment, which recorded 0.0077% in the first season and was superior to the plants treated at a concentration of 50 mg/L. In the second season, the comparison plants recorded the lowest percentage of zinc, which was 0.0065%. Whereas the highest zinc content in leaves was in the BA50 treatment in both seasons, which was recorded (0.0085 and 0.0074)% respectively, which was significantly superior over the treatment BA100 in both seasons (0.0080, 0.0070)% respectively. On the other hand, the comparison treatment recorded the lowest percentage in both seasons, which was (0.0074 and 0.0064)% respectively. The interaction treatment GA150.BA50 was significantly superior in increasing the leaf content of magnesium in both seasons reached (0.0099 and 0.0087)%, respectively, compared to the zinc content of leaves in treatment GA0.BA0, which recorded the lowest zinc content in both seasons were (0.0069 and 0.0056)%, respectively.

Table 10. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the Leaf content of Zn% of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

Season 2018						Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	0.0069	0.0075	0.0069	0.0083	0.0074	0.0056	0.0064	0.0060	0.0074	0.0064
BA50	0.0078	0.0079	0.0083	0.0099	0.0085	0.0067	0.0069	0.0073	0.0087	0.0074
BA100	0.0083	0.0075	0.0079	0.0083	0.0080	0.0073	0.0066	0.0070	0.0073	0.0070
Mean	0.0077	0.0076	0.0077	0.0088		0.0065	0.0066	0.0068	0.0078	
L.S.D. (0.05)	GA_3=0.0013 BA=0.0001 GA_3*BA=0.0003					GA3=0.0001 BA=0.00009 GA3*BA=0.0002				

- ***Leaf content of Fe%***

The results of Table 11 indicated that the high concentration of gibberellic acid led to a significant increase in the iron content of the leaves compared to the control treatment. Once the percentage of iron in the leaves of GA150 plants in both seasons became (0.0272 and 0.0240)%, respectively, which it significantly exceeded the GA50 plants for the two seasons, that recorded (0.0261 and 0.0225)%, respectively and significantly lower than the comparison treatment for both seasons after the comparison treatment recorded (0.0270 and 0.0232)% respectively. However, the treatment GA100 decreased significantly from all treatments, which gave the lowest percentage of iron in leaves for both seasons, which was (0.0248 and 0.0217)%, respectively. Further, it was noticed that the adding of benzyl adenine has led to a decrease in this characteristic, especially at treatment BA50 in both seasons, which gave (0.0244 and 0.0213)%, respectively. Finally, comparison treatment recorded the highest iron content in leaves for both seasons, it was (0.0297 and 0.0253)%, respectively, which was significantly superior over the treatment BA100, which recorded (0.0247 and 0.0219)%, respectively for both seasons. There was no significant response to the increase in the percentage of iron in the leaves due to the interaction between the two factors, as the treatment of GA0.BA0 recorded the highest percentage in both seasons (0.0330 and 0.0268)%, respectively. Besides, the treatment GA0.BA50 recorded the lowest iron content in leaves, for both seasons it was (0.0211, 0.0185)% respectively.

Table 11. The effect of gibberellic acid GA3 and benzyl adenine BA and the interaction between them on the Leaf content of Fe% of Halawani variety grape seedlings (%) for the seasons 2018 and 2019

	Season 2018					Season 2019				
BA laves	GA_3 levels				Mean	GA_3 levels				Mean
	GA0	GA50	GA100	GA150		GA0	GA50	GA100	GA150	
BA0	0.0330	0.0307	0.0246	0.0307	0.0297	0.0268	0.0262	0.0213	0.0272	0.0253
BA50	0.0211	0.0227	0.0262	0.0278	0.0244	0.0185	0.0195	0.0230	0.0245	0.0213
BA100	0.0269	0.0250	0.0237	0.0233	0.0247	0.0244	0.0220	0.0210	0.0205	0.0219
Mean	0.0270	0.0261	0.0248	0.0272		0.0232	0.0225	0.0217	0.0240	
L.S.D. (0.05)	GA_3=0.0005 BA=0.0004 GA_3*BA=0.0009					GA3=0.0006 BA=0.0005 GA3*BA=0.0011				

DISCUSSION

It is evident from the above that there are differences in the response of the vegetative growth of grape seedlings to the gibberellic acid levels used. These differences represented in the positive or negative effects of the studied characteristics, as it was observed that the treatment of spraying gibberellic acid in both seasons was significantly superior to the comparison treatment in increasing the stem length as shown in Table 1. This response may be attributed to the effect of gibberellin on elongating the stem through two physiologically different processes, where the first is represented by cell division and the second is in the cellular elongation of plant tissue cells internally. Meaning that the mother cell in which division occurs, giving, in turn, many new cells that increase in size and then divide, eventually leading to elongation of growth. . This may happen through the indirect influence of Gibberlin, where the sprayed gibberellin stimulates the production of Auxin, Otherwise, by interaction in some way with Auxin, it increases the rate of Auxin formation and a decrease in the rate of catabolism because gibberellin reduces the effectiveness of the enzyme IAA Oxidase and Peroxidase. Studies also indicate that there is a solidarity relationship between these two substances, or because of an increase in the zinc content of the leaves as shown in Table 10, which is necessary for the formation of Tryptophan, which is the first substance in the Auxin synthesis process. Furthermore, the Auxin is induced by spraying gibberellin or increased zinc, which has a role in cell growth and its importance in stimulating the processes of genetic reproduction and then stimulating the RNA synthesis and protein. Auxin works on the other hand to stimulate the wall loosening by breaking the bonding of cell walls and rearranging them in new sites under the influence of turgor pressure, which contributes to an increase in the cell size and expansion and then increasing its size by increasing its protoplasmic content. Auxins may also affect the constituent enzymes, especially the cellulase enzyme that weakens the fiber systems and building and decomposes the components of cell walls enzymes that may come through activating hydrogen ion pumping (protons), reducing cell pH and changing the bonds, and then increasing the cell wall loosening. Likewise, it leads to a change in the water relations of the plant, especially the turgor and osmotic pressure of the cell, which causes the flow of water to the cell and its increase in its expansion, ultimately leading to the elongation of growth. The results showed a significant increase in the root dry weight as shown in Table 2. The reason may be because the Auxin induced by gibberellin or by the action of zinc was effective in stimulating the root growth and thus results in an increase in the root dry weight as in Table 2. This was reflected in the increased nitrogen content in the branch as shown in Table 4, in addition to the nitrogen content of the leaves as in Table 6, phosphorous as in Table 7, potassium as in Table 8, magnesium as in Table 9, zinc as in Table 10, iron as in Table 11. The results of the statistical analysis also indicated an increase in the percentage of carbohydrates in the branches as in Table 3, and this may be due to the increase in the leaves' nutrients content above. Nitrogen involved the composition of porphyrins that enter into the formation of the chlorophyll molecule, or because of the increased content of phosphorous in leaves, which participates in the synthesis of many compounds that participate in the formation of nucleic acids. Or else those that provide energy for vital processes, especially Uridine Triphosphphat UTP, which is important in the formation of sucrose, glucose, and polysaccharides, in addition to phospholipids, which have a major role in reactions that includes the Adenosine triphosphate ATP involving. It also participates in the synthesis of the coenzyme NAD + and NADP + that contribute to the photosynthesis process or as a result of increased content of potassium in the leaves, which may lead to an increase in the fixation of carbon dioxide, which increases the activity of the photosynthesis process and thus increases the accumulation of carbohydrates. There may also be a role to increase the leaf content of magnesium, whose effect was through its entry into the chlorophyll molecule synthesis, thus increasing the leaf content of chlorophyll, which was reflected in the photosynthesis process and the increase in carbohydrate production. Conversely, zinc may have a role in increasing the percentage of carbohydrates in the branches, by activating the action of some enzymes such as Carbonic anhydrase and Enolas that contribute to the balance of photosynthesis reactions in the chloroplasts. There may be a role for iron after an increase in its percentage in the leaves over the percentage of carbohydrates in the branches through the iron participate in the composition of ferredoxin. This material is a stable receptor for electrons in the electron transport chain during the photosynthesis process in the photosynthesis system, which may be reflected in the increased formation of carbohydrates. It was observed from the statistical analysis that there are significant differences in some of the study characteristics for the seedlings treated with benzyl adenine. This is due to the positive effect of benzyl adenine on grape seedlings, where cytokinin-assembling positions are considered to attract plant sap and what it contains from materials and nutrients from other plant parts. Especially, the old ones, which leads to an increase in RNA, DNA, proteins, and enzymes, especially after increasing the nitrogen content in the leaves and branches as shown in Table 4, 6 respectively, with increasing leaf content of zinc as shown in Table 10. Consequently, it led to the degradation of chlorophyll and delayed the leaves aging and an increase in the percentage of carbohydrates in the branches as shown in Table 3 after activating the photosynthesis process. Thus, improving the vegetative growth that was reflected in increasing the stem length as shown in Table 1. Besides, the growth of its root, thus increasing the root dry weight as in Table 2, also, the increase in the percentage of zinc in the leaves as in Table 10 may have a role in increasing the stem length and increasing the root dry weight as in Table 1, 2, respectively, as mentioned above. From this, it can be concluded that gibberellin encourages or stimulates the absorption of nutrients from the soil and increases their concentration in plants more than cytokinin.

REFERENCES

1. AL-Asady, Maher H.S., and AL- Kikhani, Ali H. J. 2019. Plant Hormones & Their Physiological Effects. AL-Qasim Green University-Agriculture College.
2. Haynes, R.J. 1980. A comparison of two modified Kjedhal digestion techniques for multi-elements plant analysis with conventional wet and dry ashing Methods. communein. soil sci. plant Analysis. 11(5):459-467.
3. Hedden, Peter, and Stephen G. Thomas. 2006. Plant Hormone signalin. Printed and bound in India by Replika press Prt. Ltd., Kundli.
4. Jackson, M.L. 1985. Soil Chemical analysis. Prentice Hall, Inc. Englewood Cliff, N.J. The USA. P.225-276.
5. Jasim, Ali L. 2012. Knowledge of grape farmers in the area of service of the crop and its relationship with some factors in the district of balad. The Iraqi Journal of Agricultural Scinces 43(4):121-135.
6. Jones, J.B., and W.J.A. Steyn. 1973. Sampling, Handling, and Analyzing plant tissue samples. P. 248-268. In: Soil Testing and plant Analysis. ed by walsh, L.M. and J. D. Beaton. Soil Sience Society of America, Inc, 677 South Segee Rd, Madison, Wiscon sin, USA.
7. Joslyn, M. A. 1970. Methods in food analysis, physical, chemical and in strumentel methods of analysis,2nd ed. Academic Press. New Yourk and London.
8. Leavitt, G.M. and Munnecke, D.E. (1987). The occurrence and distribution of Botryodiplodia theobromae on grapes (*Vitis vinifera* L.) in California. Phytopathol. 77: 1690.
9. Page, A. I. 1982. Methods of soil analysis. part2. Chemical and Micro biological properties. Amer. Soc. Agron. Midison. Wisconsin.USA.
10. Taiz, L. and D. Zeiger. 2010. Plant Phsiology. Fourth Edition. Sinauer Assciates Inc., Publishers Sunderland, MA., USA.