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IMPACT OF AUXIN AND NUMBER OF BUDS LEFT IN CUTTINGS FOR THE ROOTING AND GROWTH OF GRAPE TRANSPLANTS OF CV. HALWANI AND KAMALI

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Abstract

This study investigated the effect of treating cuttings with auxin indole butyric acid (IBA) at three concentrations of 0, 500, and 1000 mg L^{-1} by rapid immersion for 10 seconds. The number of buds on the cuttings were determined at three levels (3, 5 and 7 bud $cutting^{-1}$) on the rooting and vegetative growth of grape transplants of Halwani and Kamali cultivars. Each cultivar had 135 cuttings for a total of 270 cuttings for both cultivars. Dipping the cutting bases of the cultivars with IBA in 1000 mg L^{-1} concentration resulted in significant superiority in the percentage of rooted cuttings, average root length, root dry weight, vegetative system dry weight, average transplant height, diameter, number of leaves, leaf area and chlorophyll content. The auxin treatment did not affect the leaves nitrogen content for both cultivars. The 3- and 5-buds $cutting^{-1}$ of the Halwani grape cultivar had a significant effect on the rooted cuttings, reaching 95.00 and 95.56%, respectively, while the 5-bud cuttings of the Kamali cultivar significantly increased the number of rooted cuttings and total nitrogen in the leaves at 99.33 and 2.53%, respectively. Cuttings of 5 buds from both cultivars had a significant effect on their average root length, dry weight of the root and vegetative system, average transplant height, number of leaves, leaf area and leaf content of

chlorophyll. However, average transplant diameters for both cultivars were not affected by the number of buds left on the cuttings.

Keywords: Auxin, IBA, Cuttings Vitis vinifera L., Halwani, Kamali.

تأثير الأوكسين وعدد البراعم المتروكة على العقل في تجذير ونمو شتلات العنب صنفي حلواني وكمالي

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الخلاصة

اجريت الدراسة في الظلة الخشبية التابعة لقسم البستنة وهندسة الحدائق/ كلية الزراعة–جامعة كركوك، العراق خلال موسم النمو 2024 لدراسة تأثير معاملة العقل بالاوكسين (IBA) وبثلاث تراكيز (0، 500، 1000) ملغم لتر$^{-1}$ بطريقة الغمر السريع لمدة 10 ثواني وعدد البراعم المتروكة على العقل بثلاث مستويات 3، 5، 7 برعم عقلة$^{-1}$ في النمو الجذري والخضري لشتلات العنب صنفي حلواني وكمالي، كانت عدد العقل لكل صنف 135 عقلة وعدد العقل الكلية في التجربة 270 عقلة لكلا الصنفين، ويمكن تلخيص النتائج التي تم الحصول عليها بما يلي: ادت تغطيس قواعد العقل للصنفين حلواني وكمالي بتركيز 1000 ملغم لتر$^{-1}$ من IBA الى تفوق معنوي في نسبة العقل المجذرة ومعدل طول الجذر والوزن الجاف للمجموع الجذري والخضري ومعدل ارتفاع وقطر الشتلة وعدد الاوراق ومساحة الورقة ومحتواها من الكلوروفيل الكلي، في حين لم تؤثر مستويات الأوكسين في نسبة النتروجين الكلي في الاوراق ولكلا الصنفين. وكان العقل ذات 3 و5 برعم عقلة$^{-1}$ للعنب صنف حلواني تأثير معنوي في نسبة العقل المجذرة اذ بلغ 95.00 و95.56% على التوالي، بينما كان العقل ذات 5 براعم للصنف كمالي تأثير معنوي في زيادة نسبة العقل المجذرة والنتروجين الكلي في الاوراق وبلغ 99.33، 2.53%، واثرت العقل 5 براعم للصنفين حلواني وكمالي تأثير معنوي في معدل طول الجذر والوزن الجاف للمجموع الجذري والخضري ومعدل ارتفاع الشتلة وعدد الاوراق ومساحة الورقة ومحتوى الاوراق من الكلوروفيل الكلي، اما صفة قطر الشتلة فلم تتأثر بعدد البراعم المتروكة على العقل ولكلا الصنفين الحلواني والكمالي.

كلمات مفتاحية: الأوكسين، IBA، العقل .Vitis vinifera L، حلواني، كمالي.

Introduction

The *Vitis vinifera* L. grape belongs to the Vitaceae family. Its plants are perennial climbers and contain tendrils opposite the leaves, while its flowers are either hermaphrodite or dioecious (8). The grapes are propagated vegetatively using parts of the canes or branches by rooting them. Cutting is one of the important methods of vegetative propagation, as the seed and seedless varieties are propagated in this way, and the resulting transplants are identical in their characteristics to their mother plants. This allows the desired varieties to be preserved, as well as makes it possible to produce large numbers of plants in a small space and from a small number of mother plants (4 and 6).

The cuttings can be treated with plant hormones (auxins) to increase rooting rates and improve the quality and number of roots. Indole butyric acid (IBA) is one of the most widely used compounds for encouraging the formation of lateral roots on cuttings because it is non-toxic over a wide range of concentrations and effective in forming roots in a large number of plants. It is slowly broken down by enzymes that decompose auxins due to its slow movement, as it remains close to the place of its addition (28).

A number of researchers have studied the different effects of IBA on the rooting of fruit cuttings. In their study on the effect of auxins on the rooting of European grape cuttings (21) concluded that adding a concentration of 1 mg L^{-1} of IBA to the culture medium of French Black grapes led to a significant increase in the number and length of roots. (2) found that applying different concentrations of IBA on the roots of fig cuttings by rapid immersion led to significant increases in rooting percentages and in the lengths and diameters of the vegetative growth compared to the control treatment. Also, immersing the woody bases of Thompson Seedless grapevines with indole butyric acid led to a significant increase in rooting percentages, at 88.49% compared to 87.48% in the control treatment, and increase in the number and diameter of roots (20). (9) treated the cuttings of three grape varieties (Al-Asmi, Al-Razqi, and Al-Aswad) with indole butyric acid at a concentration of 1000 mg L^{-1} for 60 seconds. This led to an increase in the number, length, and diameter of roots, number of leaves and the height of the rooted cuttings, at 7.35, 4.21 cm, 1.77 mm, 4.45 leaf, 36.45 cm, respectively compared to the control treatment.

(8) classified the cuttings according to the number of eyes into short (1-2 eyes), long (4 eyes or more), and medium (2-3 eyes) These are commonly used as the materials responsible for root formation and are formed in the buds and leaves, and are transferred after their formation to activate the effectiveness of auxins in root formation. It was shown by (5) that the Francy grape cuttings with 4 buds had significantly higher number of leaves, branches, leaf area, dry weight of the shoot and root system, and average root length compared to the cuttings with 2 and 3 buds. (18) explained that leaving 8 eyes on the Superior grape canes led to a significant improvement in their vegetative growth characteristics, branch length and diameter, number of leaves and leaf area.

According to (14) pears propagated by two types of cuttings (Woody and Lush) and treated with the growth regulator naphthalene acetic acid produced the best results in root and vegetative growth characteristics. The Halwani grape cultivar, called Wadi

grape in Iraq, are among the best table grape cultivars. It ripens at the end of September-beginning of October and requires pruning with long canes with 12 eyes. The Kamali grape cultivar ripens at the end of August-beginning of September, depending on the region and environmental conditions, and its flowers are functionally hermaphrodite, needing pollinators during its cultivation (3 and 8).

This research investigated the effect of the number of buds on the success rate of cuttings and their vegetative growth and the ideal concentration of the IBA growth regulator for increasing rooting rates in Halwani and Kamali grape cultivar cuttings.

Materials and Methods

The study was conducted in the lath house of the Department of Horticulture and Landscape Engineering, College of Agriculture, University of Kirkuk, Iraq during the 2024 growing season. Cuttings were prepared from the grape orchard of the College of Agriculture in Sayada station from healthy mothers free of disease and pests. Five-year-old Halwani and Kamali cultivars were selected on 2/20/2024 from one-year-old canes and divided according to the number of buds into 3, 5 and 7 bud cuttings^{-1}. The bases of the cuttings were immersed in three concentrations of auxin indole butyric acid at 0, 500, and 1000 mg L^{-1} by the rapid immersion method for 10 seconds. They were then planted in black polyethylene bags containing 3 kg of soil of a growing medium (mixture: peat moss at a ratio of (1:2).

Two independent experiments were conducted for each cultivar according to a complete randomized block design as a factorial experiment with three replicates and 5 cuttings for each experimental unit. The number of cuttings for each cultivar was 135 bringing the total to 270 for both cultivars. The data were statistically analyzed according to the Anov Table using the SAS (28) system for analyzing agricultural experiments, and the means compared using the Duncan multiple range test at a 5% probability level (22).

Studied characteristics: The following measurements were taken 14 weeks after transplanting the cuttings:

1. Root-cutting percentage: measured based on the following equation:

$$\text{Percentage of rooting cuttings} = \frac{\text{number of rooting cuttings}}{\text{number of planted cuttings}} \times 100$$

2. Average root length (cm): measured using a tape measure after placing the bags inside containers filled with water to break up the soil for the purpose of detecting the root system and measuring the length of the roots.
3. Dry weight of root and shoot (g): the transplants were uprooted at the end of the experiment and the shoots separated from the roots using pruning shears. Each part was washed with water to remove the soil, dried, and placed in perforated bags in an electric oven at a temperature of 70 °C$\pm$5 (7). It was then weighed with a sensitive electronic balance.
4. Average transplant height (cm).
5. Average transplant diameter (mm).
6. Average number of leaves per transplant (leaf transplant^{-1}).
7. Leaf area (cm^2): calculated according to (23) and the following equation:

$$\text{Leaf area} = \frac{\text{large leaf area} \times \text{weight of cut part}}{\text{weight of large leaf}}$$

8. Leaf chlorophyll content (mg g^{-1} fresh weight): estimated according to (19).

The percentage of nitrogen in leaves (%): samples were digested according to (16), and the nitrogen content determined using the Micro-Kjeldahl device and according to the method by (1).

Results and Discussion

Effect of auxin: It is noted from Table 1 that dipping the bases of the Halwani grape cultivar cuttings in a 1000 mg L^{-1} concentration of the auxin IBA significantly increased the percentage of root cuttings, average root length, dry weights of the root and vegetative system, average transplant height, number of leaves, leaf area, and leaf content of chlorophyll, which reached 98.33%, 10.87 cm, 10.42 gm, 24.58 gm, 30.04 cm, 17.35 leaf $transplant^{-1}$, 57.95 cm^2, and 10.53 mg g^{-1} fresh weight, respectively. The concentrations of 500 and 1000 mg L^{-1} of IBA had a significant effect on increasing average transplant diameters at 13.17 and 13.41 mm, respectively compared to the control treatment of 12.63 mm, while leaf nitrogen percentage was not affected by the IBA auxin levels.

Table 2 shows that the auxin IBA had a significant effect in improving the rooting of the cuttings and the growth of the Kamali grape cultivars. The 1000 mg L^{-1} concentration significantly increased the percentage of rooted cuttings, average root length, dry weight of the root and vegetative system, average transplant height and diameter, number of leaves, leaf area and leaf content of chlorophyll. It gave the highest rate of 97.22%, 10.01 cm, 11.19 gm, 23.73 gm, 28.43 cm, 13.25 mm, 16.20 leaf $transplant^{-1}$, 56.78 cm^2, and 11.80 mg g^{-1} fresh weight, respectively, an increase of 3.06, 31.71, 37.3, 12.04, 20.7, 4.49, 19.11, 21.09, and 21.15%, respectively over the control treatment. There were no significant effects of the IBA concentrations on the percentage of nitrogen in leaves.

Table 1: Effect of Auxin on Root and Vegetative Growth Characteristics of the Halwani Cultivar.

IBA (mg L^{-1})	Rooted cuttings (%)	Root length (cm)	Dry weight of root system (g)	Transplant height (cm)	Transplant diameter (mm)
0	90.44 c	8.06 c	8.43 c	26.55 c	12.69 b
500	94.44 b	9.41 b	9.20 b	28.24 b	13.17 ab
1000	98.33 a	10.87 a	10.42 a	30.04 a	13.41 a
IBA (mg L^{-1})	**Number of leaf transplants (leaf $transplant^{-1}$)**	**Leaf area (cm^2)**	**Dry weight of vegetative system (gm)**	**Leaf content of chlorophyll (mg g^{-1} fresh weight)**	**Nitrogen (%)**
0	16.11 c	49.01 c	20.66 c	8.01 c	2.41 a
500	16.77 b	55.35 b	22.86 b	9.81 b	2.43 a
1000	17.35 a	57.95 a	24.58 a	10.53 a	2.46 a

Numbers with the same letters are not significantly different based on Duncan's multiple range test at 0.05%.

Table 2: Effect of Auxin on Root and Vegetative Growth Characteristics of the Kamali Cultivar

IBA (mg L^{-1})	Rooted cuttings (%)	Root length (cm)	Dry weight of root system (g)	Transplant height (cm)	Transplant diameter (mm)
0	94.33 c	7.60 c	8.15 c	23.55 c	12.68 b
500	96.33 b	8.27 b	10.08 b	27.32 b	12.47 b
1000	97.22 a	10.01 a	11.19 a	28.43 a	13.25 a
IBA (mg L^{-1})	**Number of leaf transplants (leaf transplant^{-1})**	**Leaf area (cm^2)**	**Dry weight of vegetative system (gm)**	**Leaf content of chlorophyll (mg g^{-1} fresh weight)**	**Nitrogen (%)**
0	13.60 c	46.89 c	21.09 b	9.74 b	2.30 a
500	15.24 b	51.21 b	21.63 b	10.43 b	2.35 a
1000	16.20 a	56.78 a	23.73 a	11.80 a	2.42 a

Numbers with the same letters are not significantly different based on Duncan's multiple range test at 0.05%.

Effect of number of buds: Table 3 shows that the number of buds left on the Halwani grape cultivar cuttings has a significant effect on the rooting and growth of the transplant. The cuttings with 3 and 5 buds gave the highest percentage of rooted cuttings at 95.00 and 95.56%, respectively, compared to the 7-bud cuttings of 92.67%. The 5-bud cuttings gave the highest rate in average root length, dry weight of the root and vegetative system, average transplant height, number of leaves, leaf area and leaf content of chlorophyll at 10.00 cm, 11.98 gm, 26.35 gm, 31.34 cm, 19.19 leaf transplant^{-1}, 65.44 cm2, and 11.48 mg g^{-1} fresh weight, respectively, significantly superior to the rest of the 3 and 7 bud cuttings. There was no significant effect of the number of buds on stem diameter and percentage of nitrogen in the leaves.

As seen in Table 4, the 5-bud cuttings improved the rooting of the cuttings and the growth of the Kamali cultivar. They produced significantly superior results for percentage of rooted cuttings, average root length, dry weight of the root and vegetative system, average transplant height, number of leaves, leaf area, leaf content of chlorophyll and percentage of nitrogen in leaves at 99.33%, 9.04 cm, 11.42 gm, 25.12 gm, 28.98 cm, 17.96 leaf transplant^{-1}, 67.02 cm^2, 12.48 mg g^{-1} fresh weight, and 2.53%, respectively compared to the levels 3- and 7-bud cuttings^{-1}. The highest transplant diameter rate was for the cuttings with 5 buds, reaching 12.99 mm, not considerably different from the 3- and 7-bud cuttings of 12.73 and 12.69 mm, respectively.

Table 3: Effect of Number of Buds on Root and Vegetative Growth of the Halwani Cultivar.

Number of buds (bud cutting^{-1})	Rooted cuttings (%)	Root length (cm)	Dry weight of root system (g)	Transplant height (cm)	Transplant diameter (mm)
3	95.00 a	9.21 b	8.38 b	24.43 c	12.80 a
5	95.56 a	10.00 a	11.98 a	31.34 a	13.25 a
7	92.67 b	9.13 c	7.69 c	29.06 b	13.21 a
Number of buds (bud cutting^{-1})	**Number of leaf transplants (leaf transplant^{-1})**	**Leaf area (cm^2)**	**Dry weight of vegetative system (gm)**	**Leaf content of chlorophyll (mg g^{-1} fresh weight)**	**Nitrogen (%)**
3	13.09 c	40.11 c	18.93 c	7.22 c	2.29 a
5	19.19 a	65.44 a	26.35 a	11.48 a	2.51 a
7	17.96 b	56.76 b	22.82 b	9.65 b	2.51 a

Numbers with the same letters are not significantly different based on Duncan's multiple range test at 0.05%.

Table 4: Effect of Number of Buds on Root and Vegetative Growth of the Kamali Cultivar.

Number of buds (bud cutting^{-1})	Rooted cuttings (%)	Root length (cm)	Dry weight of root system (g)	Transplant height (cm)	Transplant diameter (mm)
3	94.89 b	8.55 b	9.05 b	25.40 b	12.73 a
5	99.33 a	9.04 a	11.42 a	28.98 a	12.99 a
7	93.67 c	8.30 c	8.94 b	24.92 c	12.69 a
Number of buds (bud cutting^{-1})	**Number of leaf transplants (leaf transplant^{-1})**	**Leaf area (cm^2)**	**Dry weight of vegetative system (gm)**	**Leaf content of chlorophyll (mg g^{-1} fresh weight)**	**Nitrogen (%)**
3	11.00 c	36.78 c	19.67 c	9.09 c	2.29 b
5	17.96 a	67.02 a	25.12 a	12.48 a	2.53 a
7	16.08 b	51.10 b	21.65 b	10.40 b	2.26 b

Numbers with the same letters are not significantly different based on Duncan's multiple range test at 0.05%.

Interference effect: Table 5 shows that interference between auxin concentrations and the number of buds left on the cutting had a significant effect on the studied characteristics of the Halwani grape cultivar. The interaction at 1000 mg L^{-1} IBA concentration with a level of 5-bud cutting^{-1} was superior giving the highest rate in percentage of rooted cuttings, reaching 100%. This was not significantly different from the same concentration with the 3-bud cuttings of 99.33%, which significantly outperformed the rest of the interferences for the same characteristic.

The 1000 mg L^{-1} IBA concentration interference with the level of 5 bud cutting^{-1} significantly increased average root length, dry weight of the root and vegetative system, average transplant height, number of leaves, leaf content of chlorophyll, reaching 11.08 cm, 12.72 gm, 28.15 gm, 19.85 leaf transplant^{-1}, and 12.35 mg g^{-1} fresh weight, respectively over the others. As for the average stem diameter trait, the same concentration with 7-bud cuttings had the highest rate of 13.81 mm, and the concentrations of 500 and 1000 mg L^{-1} of IBA interferences with 5-bud cuttings were

significantly superior to the rest of the interferences in leaf area, reaching 67.74 and 65.47 cm^2, respectively. There was no significant effect of the interferences on the percentage of nitrogen in the leaves of the Halwani grape cultivar.

Table 6 shows the results of the interference between auxin concentrations and the number of buds left on the Kamali grapes cuttings. The 500 and 1000 mg L^{-1} IBA concentrations interacting 5-bud $cutting^{-1}$ significantly outperformed the others in percentage of rooted cuttings, dry weight of the root system and the percentage of nitrogen in the leaves at 100%, 11.57 and 11.95 gm, 2.57 and 2.60%, respectively. Meanwhile, the 1000 mg L^{-1} IBA concentration interacting with the 5-bud $cutting^{-1}$ was significantly superior in average root length, transplant height, number of leaves, leaf area, dry weight of vegetative system and chlorophyll content of leaves reaching 10.15 cm, 29.91 cm, 19.32 leaf $transplant^{-1}$, 69.19 cm^2, 25.93 gm, and 12.85 mg g^{-1} fresh weight, respectively compared to other interferences. As for seedling diameter, the 1000 mg L^{-1} IBA concentration interference with the level 5 and 3 bud $cuttings^{-1}$ was significantly superior to the others reaching 13.48 and 13.25 mm, respectively.

Table 5: Effect of Auxin and Number of Buds on Root and Vegetative Growth Characteristics of the Halwani Cultivar.

IBA (mg L^{-1})	Number of buds (bud $cutting^{-1}$)	Rooted cuttings (%)	Root length (cm)	Dry weight of root system (g)	Transplant height (cm)	Transplant diameter (mm)
0	3	90.00 e	7.51 i	6.51 i	21.54 i	12.71 bc
	5	91.67 d	8.84 g	11.25 c	29.96 d	12.73 bc
	7	89.67 e	7.84 h	7.52 g	28.14 f	12.62 c
500	3	95.67 b	9.11 e	8.75 e	25.08 h	12.99 abc
	5	95.00 b	10.08 d	11.97 b	30.64 b	13.32 abc
	7	92.67 c	9.04 f	6.88 h	28.98 e	13.20 abc
1000	3	99.33 a	11.01 b	9.88 d	26.66 g	12.72 bc
	5	100.00 a	11.08 a	12.72 a	33.41 a	13.71 ab
	7	95.67 b	10.52 c	8.66 f	30.07 c	13.81 a
IBA (mg L^{-1})	**Number of buds (bud $cutting^{-1}$)**	**Number of leaf transplants (leaf $transplant^{-1}$)**	**Leaf area (cm^2)**	**Dry weight of vegetative system (gm)**	**Leaf content of chlorophyll (mg g^{-1} fresh weight)**	**Nitrogen (%)**
0	3	12.73 i	36.75 e	17.80 i	6.66 i	2.28 a
	5	18.25 d	60.09 b	23.33 d	9.94 e	2.50 a
	7	17.36 f	50.18 c	20.85 f	7.44 g	2.46 a
500	3	12.99 h	40.36 de	18.76 h	6.82 h	2.23 a
	5	19.46 b	67.74 a	27.57 b	12.17 b	2.43 a
	7	17.87 e	57.94 b	22.26 e	10.45 d	2.63 a
1000	3	13.56 g	43.23 d	20.22 g	8.17 f	2.36 a
	5	19.85 a	68.47 a	28.15 a	12.35 a	2.60 a
	7	18.64 c	62.14 b	25.36 c	11.06 c	2.44 a

Numbers with the same letters are not significantly different based on Duncan's multiple range test at 0.05%.

Table 6: Effect of Auxin and Number of Buds on Root and Vegetative Growth Characteristics of the Kamali Cultivar.

IBA (mg L^{-1})	Number of buds (bud $cutting^{-1}$)	Rooted cuttings (%)	Root length (cm)	Dry weight of root system (g)	Transplant height (cm)	Transplant diameter (mm)
0	3	92.00 g	7.00 f	6.23 g	19.84 g	12.13 bc
	5	98.00 b	8.29 d	10.75 bc	28.45 b	12.94 abc
	7	93.00 f	7.52 e	7.48 f	22.37 f	12.96 abc
500	3	96.00 d	8.56 cd	9.86 d	27.55 c	12.81 abc
	5	100.00 a	8.67 c	11.57 a	28.58 b	12.54 abc
	7	93.00 f	7.58 e	8.80 e	25.84 e	12.07 c
1000	3	96.67 c	10.08 ab	11.08 b	28.82 b	13.25 a
	5	100.00 a	10.15 a	11.95 a	29.91 a	13.48 a
	7	95.00 e	9.80 b	10.54 c	26.56 d	13.02 ab
IBA (mg L^{-1})	**Number of buds (bud $cutting^{-1}$)**	**Number of leaf transplants (leaf $transplant^{-1}$)**	**Leaf area (cm^2)**	**Dry weight of vegetative system (gm)**	**Leaf content of chlorophyll (mg g^{-1} fresh weight)**	**Nitrogen (%)**
0	3	10.58 f	33.56 h	18.23 e	8.14 d	2.33 ab
	5	16.18 c	65.60 c	24.29 bc	12.06 abc	2.43 ab
	7	14.05 d	41.50 f	20.74 d	9.03 d	2.14 b
500	3	11.11 ef	35.25 g	18.85 e	7.97 d	2.32 ab
	5	18.39 b	66.27 b	25.14 ab	12.52 ab	2.57 a
	7	16.21 c	52.13 e	20.90 d	10.81 c	2.17 b
1000	3	11.30 e	41.50 f	21.94 d	11.17 c	2.21 b
	5	19.32 a	69.19 a	25.93 a	12.85 a	2.60 a
	7	17.97 b	59.65 d	23.32 c	11.37 bc	2.46 ab

Numbers with the same letters are not significantly different based on Duncan's multiple range test at 0.05%.

The results obtained from this study show that steeping the cutting bases with different concentrations of IBA auxin improved the root characteristics of the Halwani and Kamali cultivar cuttings. This is due to the role of auxins in the loss of differentiation and conversion of specialized cells into meristematic cells and the formation of root primordia on the cuttings (12). In addition, auxin increases sugar availability at the adventitious root formation sites and increases starch movement by raising enzyme activity related to carbohydrate metabolism, in addition to releasing the energy needed to form adventitious roots and enzymes necessary for cell division and unfolding (13). This is reflected in the higher rooted cutting percentages with the increased auxin concentrations, which increases the accumulation of nutrients in the treatment area. This is the outcome of the association of auxins with some naturally occurring substances (auxin synergist) in the presence of some specialized enzymes (poly phenol oxidase) to form conjugates (auxin conjugates) that are highly effective in forming and developing root principles (25).

The increase in the average root length is due to the role of auxin in stimulating the speed of cell division and elongation, which stimulates the early appearance of lateral roots. This results in an increase in the length of lateral roots formed on the bases of

the cuttings, thus increasing the efficiency of water and mineral absorption from the soil, stimulating the growth of green buds, and increasing the vegetative system size. This in turn improves the process of photosynthesis and the accumulation of manufactured materials in the seedling tissues (24). This is reflected positively in improving the vegetative growth characteristics of transplants. These results agree with what (9 and 20) reached when treating grape cuttings with IBA auxin.

The positive effect of bud numbers on root growth characteristics is due to their containing good levels of rooting-assisting factors such as carbohydrates and auxins necessary for root growth. The number of active buds is a source for the formation of internal auxin, and for their production of auxiliary materials that move to the bases of the cuttings to play a role with auxin in stimulating root formation, they are called rooting aids (25). Hartmann and Kester (11) indicated that the presence of specialized non-auxin substances is necessary for the formation of roots on cuttings. They are termed rooting-associated factors, and are produced in newly formed buds and leaves and are present in some plants and absent in others.

This affected the better rooting percentage and root growth characteristics of the Halwani and Kamali cultivars, which leads to increased absorption and transfer of nutrients and increased concentration in the cuttings. This, then, stimulates the growth and opening of buds, and some of them help in the formation of chlorophyll and increase its percentage in the leaves, in addition to improving vegetative growth (17 and 27). Also, the short length of the cuttings led to the directing and distribution of nutrients and plant hormones to a smaller number of vegetative branches, which increases their growth strength (10). These results conform with (5, 18 and 15).

Conclusions

Immersing the bases of the Halwani and Kamali cultivar grape cuttings in 1000 mg L^{-1} IBA concentration for 10 seconds significantly increased the rooting percentage of the cuttings and vegetative growth characteristics, except for the nitrogen percentage in the leaves, which was not affected by auxin levels. Meanwhile, the 3- and 5-bud cuttings produced the highest percentage rooting for the cuttings for both cultivars compared to the 7-bud cuttings. The level of 5 buds-cutting^{-1} had a demonstrably significant effect in increasing the root and vegetative characteristics included in the study except for the transplant diameters of the two cultivars.

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