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RESEARCH PAPER

Rooting Behavior of Six Grape Cultivars (*Vitis vinifera* L.) Using Indole Butyric Acid

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A B S T R A C T:

This experiment was conducted in plastic house of Horticulture and Landscape Design Department College of Agriculture and Forestry - University of Mosul, Iraq. For the period from February 18,2019 to May 18, 2019. To study the effect of dipping the hardwood grape cuttings in three concentrations of IBA solution 0, 1000 and 2000 mg..l^{-1} for 5 seconds on the behavior rooting ability and subsequent growth for hardwood cuttings of six grape cultivars (Zarek, Jav-Ga, Thompson Seedless, Black Rommy, Des-Alaanz and Miranee). Factorial experiment using Randomize Complete Block Design (RCBD) with three replicates per treatment, ten cuttings of each plot. The results indicated that all treatments were very effective on rooting behavior between the six grape cultivarsin this study. Black Rommy cuttings gave a significantly increase of rooting percentage compared with Jav-Ga and Miranee cultivars. The cuttings of Des-Alaanz cultivar were significantly superiority compared with others cultivars in number of roots and leaves, shoot length and dry weight of vegetative system. While Zarek cultivar was significantly superiority of compared with others cultivars in chlorophyll content and dry weight of roots system. The cuttings were treated with 1000 mg..l^{-1}(IBA) significantly superiority in rooting percentage compared with (0 and 2000 mg..l^{-1}) treatments. While the treatment of cuttings with 2000 (mg..$^{l-}$1)IBA were significantly superiority in number of roots per cuttings than (1000 and 0 mg..l^{-1})IBA treatments.

KEY WORDS: Rooting Behavior, Grape, Cultivars, IBA.
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1.INTRODUCTION:

Commercially, grapes are the world's most widespread deciduous fruit crop. Since grapes will not grow true from seeds, they must be propagated from cuttings, layering, grafting, or tissue culture (Childers *et al*. 1995). Cutting is a commercial practice for large-scale propagation in viticulture (Weaver, 1976). Adventitious root formation in cuttings is the most important morphogenesis affecting propagation success in cutting (Shiozaki *et al.* 2013). Adventitious root formation is affected by environmental conditions and exogenous and endogenous biochemical compounds. Among the endogenous compounds, auxins play a central role in the root formation of several plants.

The exogenous supply of auxins (indole-3-butyric acid (IBA) or naphthalene acetic acid) has been used for the efficient propagation of cuttings in many horticultural and forestry plants (Hartmann, *et al*.1997). The rooting ability of grape cultivar depends on the varieties and cultivars. Some cultivars of *V.vinifera*, and *V.aestivalis* cv. Norton and *V. berlandieri* × *V.rupestris* cv.140-Ruggeri, are known to be difficult to root from their hardwood cuttings 17-19 the lowest rooting rate was reported to be 23% in Norton cuttings (Kracke, *et al*.1981 and Çoban,2007). The poor rooting ability of V. kiusiana cuttings has also been reported by Mochioka *et al*. 2002. Moreover, several workers have reported that there are many advantages with the use of IBA in rooting of hardwood and soft wood cuttings of grape

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cultivars and rootstocks. Sunitha (1991) studied the effect of different plant growth regulators (IAA, IBA and NAA) at four concentrations (1000, 2000, 3000 and 4000 ppm) on rooting of four grape varieties, Gulabi, Kishmish Rozoviz, Tas-A-Ganesh and Thompson Seedless that IBA 2000 ppm gave best results with respect to percentage of rooting, number of roots, longest root, diameter of the root, fresh root weight, mean root volume, dry root weight, number of leaves and percentage of establishment in all four varieties. Reddy *et al*. (1996) studied the response of cuttings of 13 grape hybrids and varieties to seven concentrations of IBA and NAA at Bangalore and found that rooting percentage and mean root length were greatest with 1250 ppm IBA, while root number per cutting was highest with 2500 ppm IBA and rooting percentage was highest in cv. Bangalore Blue. Song *et al*. (2001) obtained best rooting when the base of the cuttings were soaked in a solution of 150 ppm IBA or NAA for 24 hours in four grape varieties derived from crosses involving *Vitis amurensis*.

The aim of this work is to elucidate the behavior study of hardwood cuttings of six cultivars grape and the effect of different concentrations of Indole Butyric Acid (IBA) on percentage rooting ability , number of roots, number of leaves, Shoot length, Chlorophyll content, dry vegetative weight , longest root and dry root weight in all six cultivars.

2. MATERIALS AND METHODS

This experiment was carried out Department of Horticulture and Landscape Design, College of Agriculture and Forestry, University of Mosul. Cuttings of six cultivars of grape for instance Zarek, Jav-Ga, Thompson Seedless, Black Rommy, Des-Alaanz and Miranee. The cutting length is between 18 to 20cm were taken from eight years old trees, growing at the Agriculture Research Center, Dohuk Governorate, Iraq's Kurdistan region. The cuttings were taken on February18,2019. The basal end of the cuttings (8-10mm) was quick immersion in Indole butyric acid (IBA) at 0,1000 and 2000 $mg.l^{-1}$ for 5 seconds. After treatment the cuttings were planted in soil medium sand in boxes in raised bed 40cmt. Full description of the tested soil is given in Table 1. After planting the experiment area was irrigated. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were 10 cuttings per treatment. The data regarding rooting percentage, number of roots per cutting, number of leaves, Chlorophyll content, shoot length, length of the longest root and dry weight of vegetative and root dry mass (g) were analyzed statically at variance and Duncan's Multiple Range Test to compare treatment means using SAS program (Mead *et al.*, 2003).

Table 1. Analysis of the tested soil, according to (Page *et al*., 1982).

Medium content	Value	Medium content	Value
N Available $mg.l^{-1}$	53	Cl^{-1} $mg.l^{-1}$	44.37
P Available $mg.l^{-1}$	8	Mg Available $mg.l^{-1}$	30.4
K Available $mg.l^{-1}$	3.988	Na Available $mg.l^{-1}$	39.99
Ca Available $mg.l^{-1}$	50	$SO_4^{=}$ $mg.l^{-1}$	11.07
Organic Matter $mg.l^{-1}$	1.17	pH	7.67
Ec (ds/m)	0.493	Sand $g.kg^{-1}$	81.65
Silt $g.kg^{-1}$	6.25	Clay $g.kg^{-1}$	12.1
Soil texture		Loam sand	

3. RESULTS and DISCUSSION

3.1 Rooting Percentage: A clear variation in the behavior of rooting the cuttings of different grape cultivars (Table 2), indicates that the heights value of rooting percentage (97.78%) was obtain on Black Roomy cultivar was significantly superior on rooting percentage. While Miranee and Jav-Ga grape cultivars gave lowest rooting percentage (81.11 and 88.89%) on the other cultivars. This may due to genetic variation and response of environmental factors on the behavior and rooting ability of different grape varieties.

Table 2. Effect of cultivars and indole butyric acid (IBA mg.l^{-1}) on percentage of rooting in hardwood cuttings of grape.

Cultivars	IBA concentrations (mg.l^{-1})			Effect of cultivars
	0	1000	2000	
Zarek	bcd 83.33	100.00 a	90.00 abc	91.11 ab
Jav-Ga	cd 80.00	96.67 ab	90.00 abc	88.89 b
Thompson Seedless	a-d 86.76	96.67 ab	86.67 a-d	90.03 ab
Black Rommy	ab 96.76	100.00 a	96.76 ab	97.83 a
Des-Alaanz	a 100.00	96.67 ab	93.33 abc	96.67 ab
Miranee	cd 80.00	90.00 abc	73.33 d	81.11 c
Effect of IBA(mg.l^{-1})	b87.78	96.67 a	88.33 b	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

The cuttings were treated with 1000 (mg..l^{-1})IBA significantly superiority in rooting percentage compared with 2000 and 0 (mg..l^{-1})IBA treatments.

This may be due to the active role and an effective of the IBA in stimulating cell elongation and formation of root principles. As well as IBA works to speed the accumulation of the encouraging rooting materials in the cuttings bases (Barcelo, *et al.*1999 ; Wynne and Mcdonald, 2002 and Hartmann, *et al.* 2014). The best rooting 100% were get from the cuttings of Zarek and Black Roomy cultivars treated with 1000 mg..l^{-1}(IBA) and the control treatment of Des-Alaanz cultivar. On the other hand Miranee cultivar treated with 2000 (mg.l^{-1})IBA resulted the lowest values (73.33%) for the rooting percentage.

The reason behind the superiority of the two cultivars Des-Alaanze and Thompson Seedless is due to the clear differentiation in the genetic variation in the cuttings content of the amount of carbohydrates and co-factors (factors associated with rooting). The auxin content to be provided in the basis of the cuttings as well as the biochemical compounds of special enzymes, especially polyphenol oxidase, which has an important role with the aforementioned compounds in the process of the emergence, composition and increase of the number of roots, which vary by cultivars, and this is in line with many researchers as (Kawai, 1996; Hartmann *et al*, 1997 and Hartmann *et al*, 2014).As well as the variation in the number of leaves by cultivar (Table,4) which have a vital role in the formation of the materials encouraging and special for the process of rooting (rowing aids) which can be transmitted to the basis of the cuttings with the content of auxin and which increase the stimulation and formation of roots (Al-Imam and Hamid, 2019).

3.2 Number of roots per cuttings:

It can be noticed from data presented in table (3) that the highest numbers of roots of the cuttings of Des-Alaanz and Thompson Seedless cultivars were significantly superiority compared with others cultivars in number of roots. While the treatment of cuttings with 2000 (mg..l^{-1})IBA were significantly superiority in number of roots per cuttings than 1000 and 0 (mg..l^{-1})IBA treatments. The highest number of roots (45 roots /cutting) were get from the cuttings of Thompson Seedless treated with 2000 (mg..l^{-1})IBA, while the lowest number of roots (11.87 roots /cutting) in Jav-Ga cuttings cultivar treated with 0 (mg..l^{-1})IBA.

Table 3. Effect of cultivars and indole butyric acid (IBAmg.l^{-1}) on number of roots in hardwood cuttings of grape.

Cultivars	IBA concentrations (mg..l^{-1})IBA			Effect of cultivars
	0	1000	2000	
Zarek	24.00 fg	30.42 c - f	36.00 a – e	30.14 b
Jav-Ga	11.87 h	12.00 h	15.25 g h	d13.04
Thompson Seedless	30.00 c-f	39.42 a – d	45.00 a	a38.14
Black Rommy	22.00 fgh	28.08 def	36.25 a – e	28.78 bc
Des-Alaanz	32.42 b-f	41.17 a b c	43.00 a b	38.86 a
Miranee	17.00 gh	25.17 efg	29.25d e f	21.085 c
Effect of IBA concentration (mg..l^{-1})	22.88 c	29.38 b	35.10 a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

3.3 Number of leaves per cuttings:

Results shown in table (4) indicates the highest number of leaves per cutting in hardwood cuttings of grape were obtained from the Des-Alaanz cultivar (19.33), whereas, the lowest value in Jav-ga (11.33), the variation in the number of leaves by cultivar may be returned to the vital role in the formation of the materials encouraging and special for the process of rooting (rowing aids) which can be transmitted to the basis of the cuttings with the content of auxin and which increase the stimulation and formation of roots (Al-Imam and Hamid, 2019). Furthermore, no significant differences were found between the control and the other two treatments of IBA concentrations on number of leaves in hardwood cuttings grape. The highest number of leave per cutting (21.67) were get from the cuttings of Thomson Seedless cultivar treated with 1000 (mg..l^{-1})IBA, while the lowest number of leaves (10.75) in Jav-Ga cuttings cultivar treated with control (0 mg..l^{-1})IBA.

Table 4. Effect of cultivars and indole butyric acid (IBAmg.l^{-1}) on leaves number in hardwood cuttings of grape.

Cultivars	IBA concentrations (mg..l^{-1})IBA			Effect of cultivars
	0	1000	2000	
Zarek	16.67 abc	18.42 abc	19.17 abc	18.08 a
Jav-Ga	10.75 c	11.58b c	11.67 bc	11.33 b
Thompson Seedless	16.33 abc	21.67 a	17.17 abc	18.39 a
Black Rommy	14.58a bc	16.92 abc	17.33 abc	16.28 a
Des-Alaanz	20.75 a	19.75 ab	17.50 abc	19.33 a
Miranee	13.08 abc	15.42 abc	17.33 abc	15.28 ab
Effect of IBA concentration (mg..l^{-1})	15.36 a	17.29 a	16.69 a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

3.4 Shoot length:

Table (5) indicates that the highest shoot length of the cuttings of Des-Alaanz cultivar were significantly superiority compared with others cultivars while no significant differences were found between the control and the other two treatments of IBA concentrations on shoot length in hardwood cutting grape. The highest shoot length (13.50 cm.) were get from the cuttings of Das- Alaanz cultivar treated with 1000 and 2000 (mg..l^{-1}) IBA), while the lowest length of shoot (7.33 cm.) in Black Roomy cuttings cultivar treated with control (0 mg.l^{-1}) IBA.

Table 5. Effect of cultivar and Indole butyric acid (IBA) on shoot length (cm.).

Cultivars	IBA concentrations (mg..l^{-1})IBA			Effect of cultivars
	0	1000	2000	
Zarek	8.92 a -d	9.67 a – d	12.33 abc	10.31 b
Jav-Ga	7.50 cd	11.08 a – d	8.25 bcd	8.94 b
Thompson Seedless	11.17 a –d	9.33 a – d	8.33b cd	9.61 b
Black Rommy	7.33 d	7.67d c	9.83 a –d	8.28 b
Des-Alaanz	12.67 ab	13.50 a	13.50 a	13.22 a
Miranee	10.17 a d	9.00 a – d	11.92 a –d	10.36 b
Effect of IBA concentration (mg..l^{-1})	9.63 a	10.04 a	10.69 a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

3.5 Chlorophyll content in leaves:

Data presented in Table (6) shows that the cuttings of Zarek cultivar was significantly superiority of compared with others cultivars in chlorophyll. while no significant differences were found between the control and the other two treatments of IBA concentrations on chlorophyll content in leaves in hardwood cutting grape.

Table 6. Effect of cultivars and indole butyric acid (IBA mg.l^{-1}) on chlorophyll content (SPAD) in leaves cuttings of grape.

Cultivars	IBA concentrations (mg..l^{-1})IBA s			Effect of cultivars
	0	1000	2000	
Zarek	7.76 ab	8.67a	8.51 a	8.31 a
Jav-Ga	6.01b cd	6.95 abc	7.81 ab	6.92 b
Thompson Seedless	5.67 cd	5.83 cd	5.62 cd	5.71 cd
Black Rommy	4.55 d	4.75 d	5.21 cd	4.84 d
Des-Alaanz	5.41 cd	5.24 cd	5.59 cd	5.41 cd
Miranee	5.81 cd	6.40 bcd	6.44 bcd	6.22 bc
Effect of IBA concentration (mg..l^{-1})	5.87 a	6.31 a	6.53 a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

The highest chlorophyll content in leave (8.67 SPAD) were get from the cuttings of Zarek cultivar treated with 1000 (mg..l^{-1}) IBA, while the lowest chlorophyll value (4.55 SPAD) in Black

Roomy leaves cultivar treated with control (0 mg..l^{-1}) IBA.

3.6 Dry weight of vegetative system:

The cuttings of Des-Alaanz cultivar were significantly superiority compared with others cultivars in dry weight of vegetative system are given in table (7). while no significant differences were found between the control and the other two treatments of IBA concentrations on dry weight of vegetative system in hardwood cutting grape. Interactions between Des-Alaanz and 2000 (mg.l^{-1}) IBA gave the highest value (1.58 g) of dry weight of vegetative system in hardwood cutting grape. while the lowest value (0.50 g) in Black Roomy cuttings cultivar treated with 0 or 1000 (mg.l^{-1}) IBA..

Table 7. Effect of cultivars and indole butyric acid (IBA mg.l^{-1}) on dry weight of vegetative system (g) in hardwood cuttings of grape.

Cultivars	IBA concentrations (mg..l^{-1}) IBA			Effect of cultivar
	0	1000	2000	
Zarek	0.92 bc	1.08 abc	1.08 abc	1.03 ab
Jav-Ga	1.08 abc	1.33 ab	1.08 abc	1.16 ab
Thompson Seedless	0.92 bc	0.92 bc	0.92 bc	0.92 b
Black Rommy	0.50 c	0.50 c	0.83 bc	0.61 c
Des-Alaanz	1.00 abc	1.25 ab	1.58 a	1.28 a
Miranee	1.08 abc	1.00 abc	1.17 ab	1.08 ab
Effect of IBA concentration (mg..l^{-1})	0.92 a	1.01 a	1.11 a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

3.7 Length of the longest root:

Data presented in Table (8) shows that the highest length of the longest root (35.42 cm.) were get from the cuttings of Des-Alaanz cultivar treated with 0 (mg.l^{-1}) IBA , as well as control treatment in Jav-Ga cuttings cultivar gave the lowest value (22.75 cm), but no significant difference was found between all cultivars, With respect to IBA concentrations (mg.l^{-1}) the highest value was found from the 2000 (mg.l^{-1}) IBA while, the lowest value was from the control.

Table 8. Effect of cultivars and indole butyric acid (IBA mg.l^{-1}) on length of longest root (cm) in hardwood cuttings.

Cultivars	IBA concentrations (mg..l^{-1}) IBA			Effect of cultivars
	0	1000	2000	
Zarek	23.11 bc	27.50 abc	30.10 abc	26.90 a
Jav-Ga	22.75 c	27.67 abc	30.00 abc	26.81 a
Thompson Seedless	28.20 abc	27.58 abc	32.60 ab	29.46 a
Black Rommy	26.25 abc	30.32 abc	31.00 abc	29.19 a
Des-Alaanz	35.42 a	25.25 bc	30.94 abc	30.54 a
Miranee	24.33 bc	31.50 abc	32.00 abc	29.28 a
Effect of IBA concentration (mg..l^{-1})	26.68 b	28.30 ab	31.11a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

3.8 Dry weight of total roots:

It can be noticed from data presented in table (9) that the highest dry weight of total root system (g) was of the cuttings of Zarek cultivar which exceeded the other cultivars, On the other hand, no significant differences were found between grape cultivars treated and untreated with all IBA concentrations. While highest dry weight of roots system (0.83 g.) were get from the cuttings of Zarek cultivar treated with 1000 mg..l^{-1}(IBA) , while the lowest value (0.42 g.) in Black Roomy cuttings cultivar treated with control and 1000 (mg.l^{-1}) IBA) .

Table 9. Effect of cultivars and indole butyric acid (IBA mg.l^{-1}) on dry weight of total root system (g) in hardwood cuttings of grape.

Cultivars	IBA concentrations (mg..l^{-1}) IBA			Effect of cultivars
	0	1000	2000	
Zarek	0.58abc	0.83a	0.75ab	0.72a
Jav-Ga	0.42c	0.58abc	0.50bc	0.50b
Thompson Seedless	0.75ab	0.50bc	0.58abc	0.61ab
Black Rommy	0.42c	0.42c	0.67abc	0.503b
Des-Alaanz	0.58abc	0.67abc	0.75ab	0.67ab
Miranee	0.50cd	0.58abc	0.50bc	0.527b
Effect of IBA concentration (mg..l^{-1})	0.541a	0.596a	0.625a	

Means with the same letters are not different significantly by Duncan's test ($P \leq 0.95$).

CONCLUSIONS:

According to the results of this study emphasized the fact that were a clear different between the cultivars under study. Using 1000 (mg. l^{-1}) IBA effectively improved the rooting of grapevine cutting. Furthermore**,** using (2000 mg. l^{-1})IBA improved the number of roots per cuttings.

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