



Effect of Cutting Type and IBA on Rooting and Growth of Citron (*Citrus medica* L)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This study was conducted during 2012 and 2013 season to investigate the effect of IBA on rooting of citron stem cuttings (*Citrus medica* Linnaeus) Corsian cultivar.

The cutting referred to the location from which it was taken (tip, medial and bottom).

Cuttings were taken and exposed to different IBA doses (0, 500, 1000, 2000 ppm). They were planted in greenhouse in mixed media (1 part peat moss + 2 parts sand) to increase rooting success percentage in the stem cuttings of (*Citrus medica* Linnaeus) Corsian cultivar, improving their vegetative growth, and investigate the response of stem cuttings of citron to Auxin IBA concentrations.

The results indicated that the type of cuttings were different in rooting capacity, shoot length content. Also increase the concentrations of IBA increased rooting percentage, shoot diameter, number of leaves, length of roots and leaves relative chlorophyll content, significantly form compared with control treatment under level 5%. The result indicated that the medial cutting parts with 500 and 1000 ppm perform better in terms of root percentage(100%), and medial type cutting with 500 IBA ppm in length of shoots(23.08 cm), shoot diameter(16.33 mm), number of leaves (16.44 leaves plant), length of roots(17.92cm).

Keywords: *Citrus medica*; IBA; citron; auxin; corsian cultivar; rooting percentage.

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1. INTRODUCTION

Citron (*Citrus medica* L) is a species of citrus fruit. It usually has a thick rind and small sections. Originally, the tree came from South east Asia that the real citron grows in the Garo Hills of Assam [1]. Today it is mainly grown in Sicily, Morocco, Crete, and Corsica, as well as Puerto Rico. The tree can grow to a height of about 3 meters. The fruit can grow to a size of about 25 cm in length, and about 4 kg in weight. The pulp of the fruit is hardly ever used. It is made into an additive for cooking. Jam can also be made from the rind. The rind is also used to make vegetable oil, which is used for perfumes.

The wild forms of citron along with those of the mandarin and pomelo Cutting propagation is often the preferred method for plant propagation. The stem cutting is suitable method for regeneration for the species. It is inexpensive, rapid and simple and does not require the special techniques as required in other vegetative methods. Other methods that are more difficult or more expensive may exist but are often not chosen. Major factors to be considered are the parent plant or stock plant and the propagating conditions along with the techniques and tools of cutting propagation [2]. This cutting may be referred to by the location from which it is taken.

Rooting of the cutting is one of the possible techniques for vegetative propagation and it was observed that cuttings play important roles in the rooting of important species of some fruit species and colonial rootstocks. The stimulation of adventitious root formation in stem cuttings treated with auxins is well known [3]. Exogenous plant growth regulators are one of the most commonly used methods in propagation. But, there are some endogenous and exogenous factors affecting rooting of cuttings such as growth substances [4,5].

[6]reported that the treatment with 1000 and 3000 ppm NAA, 1000 and 3000 ppm IBA, Rooton powder (acommercial formulation containing 2000 ppm NAA and 1000ppm IBA), and control that stem cuttings of the different clones responded significantly in root production to NAA and IBA treatments.

The concentration of 1000 NAA ppm and 3000 IBA ppm yielded the maximum rooting percentage (75%) and produced higher numbers of roots that were longer and thicker than those of control across all selection. [7] took cuttings of eight citrus rootstock and used indole butyric acid

at concentrations zero -1250-2500-5000 and 10000 ppm. Cuttings were planted in greenhouse in sandy soil . The results obtained indicated that some rootstock reopened very well to IBA treatment and the rooting percentage reached 61.1-91.7% but some other rooting percentages were only 13.3 -38.9 % and IBA at concentrations 500-2500 ppm increased significantly the number of rootstocks and the number of new shoots per rooted cutting of new rootstocks. [8] showed in the study the effect of indole butyric acid at concentrations 0,1000 and 2000 ppm used of IBA treatment had significant effect on the rooting percentage, and length roots/cutting. The present study deals with the use of cutting types and IBA for rooting nature and success percentage in stem cuttings of Citron.

[9]showed in the study the effect of indole butyric acid at concentrations 4000 ppm, that the stem cuttings of Citrus treated with IBA increased both root number and length relative to non-treated cuttings, but did not differ significantly among IBA treatments and control in the final rooting percentages.

The aims of this study are to determine the rooting percentage of various types of citrus stem cuttings by using some concentrations of auxin IBA, to increase rooting success percentage in the stem cuttings of (*Citrus medica* Linnaeus), Corsian cultivar, improving their vegetative growth and investigate the response of stem cuttings of citron to concentrations of auxin IBA.

2. MATERIALS AND METHODS

The experiment was carried out during the year of 2012-2013 in the Nursery of Department of Horticulture, Faculty of Agriculture and Forestry, Duhok University, to investigate the effect of IBA at - 0- 500 -1000 and 2000 ppm on different types stem cutting of Citron (*Citrus medica*) Corsian cultivar.

Stem cuttings (15-17 cm length \pm 1) of Citron Corsian cultivar, were taken in 23 January with three types T1 (Tip cutting), T2 (Medial cutting), T3 (Bottom cutting).The bottom parts of cuttings were treatments different IBA doses (0, 500, 1000 and 2000 ppm). Then the cuttings (5-6 nodes with 0.7 - 0.9 cm diameter) were planted in mixed media (1part peat moss to 2 parts sand). One part of Peat moss was mixed thoroughly with the 2 parts of well dried sand. This prepared media was filed in perforated

wood boxes under air condition in greenhouse in order to root (buried about 2/3 their height) by 7 x 10 cm rows. Cuttings were irrigated properly immediately after planting. Approximately 9 months after the beginning of the experiment, in the mid October, the Percentage success of rooting, plant diameters, plants length and length of roots were measured.

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications, using 30 cuttings for experimental units for the experiment. Statistical analysis systems were performed using SAS program [10].

3. RESULTS AND DISCUSSION

Table 1 shows that the type of cutting have no significant effect on percentage of rooting and the highest percentage (90.0%) where found in T2(Medial type) and the least Percentage (85.0%) was in T1 (Tip cutting), also show that IBA significantly affected the percentage of rooting cutting. The highest percentage of rooting cutting found in 1000 ppm IBA reach (93.33%) and the least percentage of rooting cutting was in (control) (71.11%) This is in agreement with what has been found by [11] in figs (*Ficus carica*) cultivars and [12] in Mulberry. While The interaction between diameter and IBA was significantly effective on percentage of rooting cutting, the highest percentage of rooting cutting was in T2 and 1000 ppm IBA (100 %), and T1 and Zero ppm IBA gave the least percentage of rooting cutting (70.00%), might be due to the co-effect of both the type and the auxin.

Results in the Table 2 indicate that the type of cutting had no significant effects on length of shoots, the highest length was in T2 (Medial cutting) 16.29 cm, and the least length was in treatment T3(Bottom cutting) 14.0 cm.

The results in the Table 2 also indicate that IBA ppm had significantly affected on the length of shoots, the highest length of shoots were in 1000 ppm IBA (16.55 cm) and the least length was in control treatment (12.11 cm) .The interaction between diameter and IBA was significantly affected the length of shoots, the highest length of transplants was in T2 +500 ppm IBA (23.08cm), and T2 + zero ppm IBA gave the least length (10.42cm), might be due to the co-effect of both the type of cutting and the auxin.

The result of in the Table 3 show that the type of cutting had significant effects on diameter of shoots, the highest diameter of transplants in treatment T2 (Medial cutting)10.88 mm, and treatment T1 (Tip cutting) had the least diameter 9.20 mm, the treated cuttings with IBA also had significantly effected on the diameter of cutting ,the maximum diameter in 2000 ppm IBA (10.54 mm) while the treatment 500 ppm IBA had least value (8.99 mm) .This is in agreement with what has been found by [11] on figs (*Ficus carica*) cultivars and [12] on mulberry (*Morus sp.*). The results in Table 3 showed increasing diameter of cuttings in interaction T2+500 ppm IBA reach 16.33 mm ,the treatment T3 + 500 ppm IBA had least value (4.91 mm) this mish be due to the co-effect of both the diameter and the auxin.

Table 1. Effect of cutting type and IBA on percentage of rooting (%)

Type of cutting	IBA concentration				Mean of cutting
	0	500	1000	2000	
Tip	70.00 c	90.00 ab	80.00 bc	100.00 a	85 a
Medial	70.00 c	100.00 a	100.00 a	90.00 ab	90.00 a
Bottom	73.33 bc	90.00 ab	100.00 a	80.00 c	85.83a
Mean of IBA	71.11 b	93.33 a	93.33 a	90.00 a	

Any two numbers followed by the same letter are not significantly different at $P \leq 0.05$ level

Table 2. Effect of type cutting and auxin IBA on length of shoots (cm. shoots)

Type of cutting	IBA concentration				Mean of cutting
	0	500	1000	2000	
Tip	14.08bcd	12.25 cd	15.57bcd	17.50 b	14.85 a
Medial	10.42 d	23.08 a	15.33bcd	16.33bc	16.29a
Bottom	11.83 cd	11.25 cd	18.75ab	14.17bcd	14.00a
Mean of IBA	12.11 b	15.53 a	16.55 a	16.00 a	

Any two numbers followed by the same letter are not significantly different at $P \leq 0.05$ level

Results in the Table 4 show no significant difference between numbers of leaves of shoots with the type of cutting. On the other hand IBA had significant effects on numbers of leaves of shoots, since 1000 ppm IBA gave (12.72 leaves. shoots) while the control treatment had least value (8.36 leaves. shoots). Regarding the effect of interaction between type of cutting and IBA, the treatment of (500 ppm IBA + Medial cutting type) gave (16,33 leaves. shoots) which was significantly higher than other numbers of leaves actions in Table 4, the lowest value of number of leaves was recorded in T1(Bottom type cutting) and 500 ppm IBA treatment (7.33 leaves. shoots). The reason might be due to the co effect of both the type of cutting and of auxin IBA.

Data presented in Table 5 declare that there were significant differences among the tested treatments in length of roots, The use of Medial cuttings gave the longest roots reach (14.81cm) whereas the least length (8.17cm) was recorded for Bottom, The use of 2000 ppm IBA gave the highest length of roots reach (13.64 cm) whereas the least content (8.81cm) was recorded for

control. The interaction treatment between medial type roots + 500 ppm IBA gave the highest length of roots reach (17.92 cm), while the shortest roots reached 6.0 cm which was recorded for the interaction between bottom cuttings + control treatment. This might be due to the combined effect between type of cuttings and IBA tested.

Data presented in Table 6 declare a significant effect of type cutting on relative chlorophyll content, the use of T3 (Bottom type cutting) gave the highest chlorophyll content in leaves estimated at (62.08 %) whereas the least content (46.41%) was recorded for (Tip type cutting). While the use of IBA refers to there were no significant differences among the tested in chlorophyll leaves content. The interaction treatment between (Bottom type cutting) and auxin IBA (zero ppm IBA gave the higher chlorophyll content in leaves (64.70%) while the least content (42.60%) was recorded for the interaction treatment between the (Tip type cutting) and auxin IBA (Zero ppm in leaves). This might be due to the co effect of both the type of cutting and of auxin.

Table 3. Effect of type cutting and auxin IBA on diameter shoots (mm. shoots)

Type of cutting	IBA concentration				Mean of cutting
	0	500	1000	2000	
Tip	12.01 b	5.75ed	6.18de	12.87b	9.20b
Medial	9.03 c	16.33a	12.25b	5.93ed	10.88a
Bottom	7.53 c d	4.91e	12.52b	12.82b	9.44b
Mean of IBA	9.52ab	8.99b	10.32ab	10.54a	

Any two numbers followed by the same letter are not significantly different at $P \leq 0.05$ level

Table 4. Effect of type cutting and auxin IBA on numbers of leaves of shoots (leaves. shoots)

Type of cutting	IBA concentration				Mean of cutting
	0	500	1000	2000	
Tip	9.17ecd	9.00ecd	11.67bcd	16.25a	11.52 a
Medial	8.00 cd	16.33a	12.25bc	8.42ecd	11.25a
Bottom	7.92 cd	7.33e	14.25bc	9.58ecd	9.77a
Mean of IBA	8.36 b	10.89a	12.72 a	11.42a	

Any two numbers followed by the same letter are not significantly different at ≤ 0.05 level

Table 5. Effect of type cutting and auxin IBA on length of roots (cm.)

Type of cutting	IBA concentration				Mean of cutting
	0	500	1000	2000	
Tip	7.67 e g	8.83efg	11.67ecd	14.50bc	10.67b
Medial	12.75bcd	17.92a	13.00bcd	15.58ab	14.81a
Bottom	6.00g	6.00g	9.83efg	10.83ed	8.17c
Mean of IBA	8.81c	10.92b	11.50b	13.64a	

Any two numbers followed by the same letter are not significantly different at $P \leq 0.05$ level

Table 6. Effect of type cutting and auxin IBA on leaves relative chlorophyll content of shoots (%)

Type of cutting	IBA concentration				Mean of cutting
	0	500	1000	2000	
Tip	42.60d	48.57bcd	45.80dc	48.67bcd	46.41c
Medial	46.50dc	49.33bcd	58.97a	55.30abc	52.53b
Bottom	64.70a	63.67a	56.60ab	63.33a	62.08a
Mean of IBA	51.27a	53.86a	53.79a	55.77a	

Any two numbers followed by the same letter are not significantly different at $P \leq 0.05$ level

4. CONCLUSION

The results of this investigation indicated that the medial stem cuttings of Citron (*Citrus medica*) Corsian cultivar effect significantly on shoots diameter, length of roots and leaves relative chlorophyll content, also the concentrations of auxin effect significantly form (IBA 500 and 1000 ppm on rooting percentage, IBA 1000 ppm on the length shoots and number of leaves, IBA 2000 on the shoot diameter, length of roots and leaves relative chlorophyll content) compared with control treatment. The best treatment was (Medial type cutting in the concentrations 500 and 1000 ppm of auxin IBA in root percentage and the concentrations 500 ppm in shoots length, diameter shoots, number of leaves and length of roots and leaves relative chlorophyll content.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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