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# The influence of growth regulators on the rooting capacity of semi hardwood cuttings of olive *Olea europaea* L.

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This research was conducted to study the influence of exogenous hormones on the rooting capacity of semi-hardwood cuttings of four olive cultivars. Cuttings were prepared and treated with indole-3-acetic acid (IAA), indole-3-butyric acid (IBA) or a-naphthalene acetic acid (NAA), at 2000 or 4000 $mgL^{-1}$ and rooted in the nursery of the Biotechnology Center, Ministry of Science and Technology in a Complete Randomized Design (CRD). The results showed that there were significant differences in the rooting percentage of the cultivars. The local olive cultivars Ashrasy and Khdary are hard to root compared with the newly introduced Coursaky and Frinto cultivars. Moreover, IBA is the best treatment for rooting semi-hardwood cuttings in 85% at 4000 $mgL^{-1}$ and 75% at 2000 $mgL^{-1}$ compared with the lowest percentage of 25% for IAA at 2000 $mgL^{-1}$ percentage and 37.5% at 4000 $mgL^{-1}$. Hormones showed great effect on the number of roots and their length. IBA at 4000 $mgL^{-1}$ gave the highest number and the longest roots in all the cultivars compared with the other treatments. IBA at 2000 $mgL^{-1}$ could also be used for rooting Coursaky and Frinto cultivars which was not significantly different than IBA at 4000 $mgL^{-1}$ in all the studied parameters.

**Keywords: semi-hardwood cuttings, Rooting, indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), naphthalene acetic acid (NAA),**

## INTRODUCTION

Olive (*Olea europaea* L.) belongs to the genus Olea, which is one of the important fruit trees of the Oleaceae family. The trees are evergreen subtropical plants which have been cultivated widely in the Mediterranean region for centuries. Olive can be propagated by seeds, however the plant is cross pollinated and the seedlings from ovules are not true to type. Thus, to avoid genetic changes the conventional propagation method is by suckers, cuttings or grafting. Most of the cultivars with preferred characteristics produce few suckers and cuttings required 6- 8 weeks for rooting while stem cuttings required 10 -12 weeks (Denney and Mc Eachern, 1984). The efficiency of this method is very low and required long time. To overcome these problems, olive breeders are using different treatments to reduce the time for rooting. Auxins have been used for many years to promote root initiation in woody plants cuttings (Basu et al., 1970, Serrano et al., 2002, Wiesman and Markus, 2002). Pio et al. (2005), Ayoub and Qrunfleh (2006) found that free auxins are increases in the rooting zone prior to rooting. Plant growth regulators at different concentrations have been used successfully to enhance rooting of some olive cultivars (Rahman et al., 2002, Serrano et al. 2002, Pio et al. 2005). However, some olive cultivars fail to initiate roots even with auxin treatments (Bartolini et al., 2008).

The Iraqi environment is suitable for olive trees growth and there are several local cultivars.

Recently, new cultivars were introduced for olive oil and fruits by the Ministry of Agriculture. To reduce the time for the propagation and the establishment of olive trees, this study was conducted to select the best growth regulator to enhance rooting of semi woody cuttings of two local and two newly introduced olive cultivars.

## MATERIALS AND METHODS

Two local olive cultivars Ashrasy and Khdary and two newly introduced Coursaky and Frinto cultivars were purchased from The Ministry of Agriculture and they were grown in the garden of the Agriculture research Center of the Ministry of Science and Technology as a source for this study. The experiment was conducted in the Nursery of the Genetic Engineering Dep. of the Ministry of Science and Technology. Semi-hardwood branches were selected and cut from the mother plants. The branches were washed with tap water before cuttings preparation. Cuttings of 3-4 mm diameter and 10 cm length with 2-4 leaves were treated with different concentrations of three growth regulators indole-3-acetic acid (IAA), a-naphthalene acetic acid (NAA), indole-3-butyric acid (IBA) by dipping them for 10 seconds (Figure 1).

**Figure 1. Olive cuttings treated with different growth regulators**

The concentrations were (0, 2000 and 4000 $mgL^{-1}$) which were mixed with pure Ethanol and Fungicide (Figure 1). After the treatment with growth regulator the cuttings were grown in pots of 10 X 15 cm filled with peat moos. The pots were arranged in complete randomized design (CRD) with 3 replications and 15 cuttings per treatment. Data were recorded after 3 months which included rooting percentage, number of roots per cutting and length of roots per cutting. The parameters were analyzed using GeneStat and the means were compared by LSD at ($P \leq 0.05$).

## RESULTS AND DISCUSSION

The results showed that no roots were developed in the control treatment except on few cuttings; therefore it was excluded from the statistical analysis. Variations were found among the cultivars in all the studied parameters (Figure 2). Significant differences were found among the cultivars in the rooting percentages of the semi woody cuttings (Table 1). Frinto cultivar gave the highest percentage of rooting which was 61.67% which was not significantly different from the Coursaky 56.67%. However, both of them are significantly different than the other two cultivars in the rooting percentage. On the other hand, the auxin type showed great effect on the rooting percentage. IBA at 4000 mg $L^{-1}$ was significantly different than all the treatments with rooting percentage reached 85% followed by IBA at 2000 mg $L^{-1}$ 75%. The lowest rooting percentage was recorded for IAA at 2000 mg $L^{-1}$ which was 25%. For the interaction between the cultivars and the auxins, the results showed that Frinto and Coursaky treated with IBA at 2000 mg $L^{-1}$ or 4000 mg $L^{-1}$ recorded the highest rooting percentage which were significantly different than the other treatments except the cultivars Ashrasy and Khdary treated with IBA 4000 mg $L^{-1}$.

Moreover, the results showed that lowest number of roots was recorded from Ashrasy cultivar which was significantly less than the other three cultivars under investigation (Table 2). However, there was significant effect for the auxins on the number of roots per cuttings. IBA at the two concentrations was significantly different than the other treatments. The highest number of roots was recorded for IBA 4000 mg $L^{-1}$ treatment 15.33 roots/ cuttings and the lowest was for IAA 2000 mg $L^{-1}$ 1.67 roots/ cuttings (Table 2).

The interaction analysis between the auxins and the cultivars showed that all the cultivars treated with IBA 4000 $mgL^{-1}$ and Frinto treated with IBA 2000 $mgL^{-1}$ were significantly different than the other interactions. The highest number of roots was recorded for Coursaky treated with IBA 4000 $mgL^{-1}$ and the lowest was for Ashrasy and Khdary treated with IAA 2000 $mgL^{-1}$ (Table 2). The average root length was varied among the cultivars (Table 3). Frinto recorded the highest followed by Coursaky and both are significantly different than the other two cultivars. Noticeable effect for the auxin treatments was found on the average root length with the longest roots recorded for IBA 2000 $mgL^{-1}$ followed by IBA 4000 $mgL^{-1}$

**Table 1. Effect of auxins on the cuttings rooting percentage of four olive cultivars**

| AUX / CUL | Auxins (mg L $^{-1}$) | | | | | | Means |
|---|---|---|---|---|---|---|---|
| | IAA 2000 | IBA 2000 | NAA 2000 | IAA 4000 | IBA 4000 | NAA 4000 | |
| **Coursaky** | 30.00 | 90.00 | 40.00 | 30.00 | 90.00 | 60.00 | 56.67 |
| **Frinto** | 30.00 | 90.00 | 60.00 | 60.00 | 90.00 | 40.00 | 61.67 |
| **Ashrasy** | 20.00 | 50.00 | 20.00 | 20.00 | 80.00 | 20.00 | 35.00 |
| **Khdary** | 20.00 | 70.00 | 40.00 | 40.00 | 80.00 | 50.00 | 50.00 |
| **means** | 25.00 | 75.00 | 40.00 | 37.50 | 85.00 | 42.50 | |
| **L.S.D $_{0.05}$** | Cultivar = 6.11 Auxin = 7.49 Cultivar X Auxin = 14.98 | | | | | | |

**Table 2. Number of roots of four olive cultivars as affected by auxins**

| AUX / CUL | Auxins (mg L $^{-1}$) | | | | | | means |
|---|---|---|---|---|---|---|---|
| | IAA 2000 | IBA 2000 | NAA 2000 | IAA 4000 | IBA 4000 | NAA 4000 | |
| **Coursaky** | 1.67 | 10.00 | 7.00 | 2.33 | 17.00 | 6.00 | 7.33 |
| **Frinto** | 2.33 | 15.00 | 4.00 | 9.00 | 15.33 | 5.00 | 8.44 |
| **Ashrasy** | 1.33 | 5.00 | 2.00 | 2.00 | 14.33 | 1.00 | 4.28 |
| **Khdary** | 1.33 | 10.67 | 6.00 | 6.00 | 14.67 | 6.00 | 7.44 |
| **means** | 1.67 | 10.17 | 4.75 | 4.83 | 15.33 | 4.50 | |
| **L.S.D $_{0.05}$** | Cultivar = 1.68 Auxin = 2.06 Cultivar X Auxin = 4.13 | | | | | | |

**Figure 2. Rooted cuttings from different treatments; variations in the number and length of roots**

**Table 3. Average root length of 5 cuttings (cm) of four olive cultivar as affected by auxins**

| AUX / CUL | Auxins (mg L $^{-1}$) | | | | | | means |
|---|---|---|---|---|---|---|---|
| | IAA 2000 | IBA 2000 | NAA 2000 | IAA 4000 | IBA 4000 | NAA 4000 | |
| **Coursaky** | 0.47 | 9.70 | 0.97 | 1.90 | 9.80 | 2.20 | 4.17 |
| **Frinto** | 2.90 | 9.93 | 2.00 | 4.87 | 7.37 | 0.70 | 4.63 |
| **Ashrasy** | 0.57 | 5.60 | 1.20 | 1.63 | 7.30 | 0.53 | 2.81 |
| **Khdary** | 0.67 | 4.07 | 2.50 | 1.80 | 1.63 | 1.30 | 1.99 |
| **means** | 1.15 | 7.32 | 1.67 | 2.55 | 6.52 | 1.18 | |
| **L.S.D $_{0.05}$** | Cultivar = 0.72 Auxin = 0.89 Cultivar X Auxin.= 1.78 | | | | | | |

and both are significantly different than the other treatments. Analysis of the interaction effect on the average root length showed that the longest roots were recorded for Frinto treated with IBA 2000 $mgL^{-1}$ followed by Coursaky treated with IBA 4000 and 2000 $mgL^{-1}$ and those interactions are significantly different than the other interactions. The shortest roots were recorded for Coursaky treated with IAA 2000 $mgL^{-1}$ (Table 3).

## DISCUSSION

Stem cutting is simple, fast and economic method for mass production of vegetative propagated trees. Meanwhile it conserves the genetic content of the plant and produce true to type trees. In the past, hardwood cuttings were used which require old plants with a lot of branches. Later, they were replaced by semi hardwood cuttings which can be obtained from one year old tree or branches and thus reducing the time for the establishment of the new trees. This method has been used for olive propagation in many countries since the establishment of the technique by Hartmann in the mid-forties of the last century (Hartmann, 1946). In the current study semi hardwood were used as starting material for the establishment of olive trees to spread the newly introduced cultivars.

Rooting ability of olive semi hardwood cuttings is very low and olive cultivars varied in their rooting capacity (Fabbri et al., 2004; Wiesman and Lavee, 1995). Some cultivars are classified as hard-to-root and others are easily- to-root (Sebastiani and Tognetti, 2004; Hegab, 2010; Vemmos, and Roussos, 2012). Variation in the rooting capacity of the cultivars under investigation is very noticeable. The control treatment of all the cultivars recorded very low rooting percentage. This result is in agreement with the results found by Hechmi et al., (2013).

The local cultivars in the present study showed less rooting ability than the new cultivars with the addition of different hormones. Thus, Ashrasy and Khdary might be classified as hard to root cultivars compared with Coursaky and Frinto cultivars. Exogenous hormones have been used to stimulate adventitious root formation in olive Semi-woody cuttings (Bartolini and Ministro, 1981; Turkoglu and Durmus, 2005). Even with the addition of hormones, hard to root cultivars show very low response for rooting ability (Wiesman and Lavee, 1995; Vemmos and Roussos, 2012).

Treating Semi-woody cuttings with auxins is one of the most effective approaches to increase the rooting ability of many species (Avidan and Lavee, 1978; Turkoglu and Durmus, 2005; Isfendiyaroglu and Ozeker, 2008, Isfendiyaroglu, 2016). Several studies showed that free auxins are accumulated in the bases of cuttings (Pio et al., 2005; Ayoub and Qrunfleh 2006). Such accumulation stimulates initiation of adventitious roots and cell division of root primordial. The results of the present study showed variations in the rooting percentage of the cuttings under the influence of different hormones. IAA treatment in both concentrations recorded the lowest rooting percentage followed by NAA. Low rooting percentage with NAA treatment is reported by other researchers (Isfendiyaroglu and Ozeker, 2008). Moreover, the results indicated that IBA at 4000 $mgL^{-1}$is the best for rooting all the studied cultivars. This result is in agreement with the results reported by several researchers (Wiesman and Lavee, 1995; Sebastiani and Tognetti, 2004; Gerrakakis and Ozkaya, 2005; Asl Moshtaghi and Shahsavar, 2011).

Moreover, auxins affected the number of roots as well as their length. IBA at 4000 $mgL^{-1}$ recorded the highest number of roots in all cultivars while IBA at 2000 $mgL^{-1}$ recorded high number of roots only in Frinto cultivar. The last treatment also recorded the longest roots in Coursaky and Frinto. Several studies reported similar results indicating the positive effect of IBA on the number and length of the roots in different species (Sharma and Aier, 1989; Sebastiani and Tognetti, 2004).

IBA is a synthetic auxin which has been used for rooting of many plant species because it is stable and non-toxic to plant. It has great effect on cell elongation and division (Hartmann et al., 2002).

## CONCLUSION

In conclusion, this study showed that there are significant differences among the cultivars in the rooting capacity. The local olive cultivars (Ashrasy and Khdary) have less rooting capacity than the newly introduced (Coursaky and Frinto) cultivars. Moreover, IBA at 4000 $mgL^{-1}$ is the best treatment for semi- hardwood cuttings which gave high rooting percentage, high number of roots and longer roots compared with the other treatments. IBA at 2000 $mgL^{-1}$ could be used for rooting Coursaky and Frinto cultivars.

## CONFLICT OF INTEREST

The present work was performed in absence of any conflict of interest.

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**AUTHOR CONTRIBUTIONS**

The present research was suggested by Dr. Zahra N. Al Hattab who also wrote the manuscript. Wathiq. A. Abdulmajeed and Falah N. Hussain conducted the experiment and collected the data. All authors reviewed and approved the final manuscript



**REFERENCES**

Asl moshtaghi E. and. Shahsavar AR, 2010. Endogenous Promoters and Inhibitors in Olive Cuttings in Relation to Adventitious Root Formation. J. Biol. Environ. Sci. 4(12): 143-148

Avidan, B, and Lavee, S, 1978. Physiological aspects of the rooting ability of olive cultivars. Acta Horticulturae 79: 93-101.

Ayoub SJ and Qrunfleh M, 2006. Seasonal variation in rooting "Nabali" and Raseei" olive cuttings in relation to shoot content of endogenous plant hormones. J. Agricultural. Science 2:15-27.

Bartolini G and Ministor M, 1981. The effect and interactions of various growth regulators on the rooting and growth of olives in the nursery. Hort. Abst 1982, 52:5796.

Bartolini G, Petrucceli R and Pestelli P, 2008. Preliminary study on in vivo rooting of two *Olea europaea* L. genotypes. Acta Hort 791: 191-195.

Basu R N, Roy BN and Bose TK, 1970. Interaction of Abscisic Acid and auxins in rooting of cuttings. Plant and Cell Physiol. 11:681-684.

Denney JO and McEachern G, 1984. The olive, this adaptable tree offers future possibilities for Texas. The Texas Horticulturist, December pp.1- 6.

Fabbri A, Bartolini G, Lambardi M and Kailis S, 2004. Olive propagation manual. Landlinks press, Colling wood, Australia, ISBN: 13-9780643099388, pp: 160.

Gerrakakis A C and Ozkaya M T, 2005. Effects of cutting size, rooting media and planting time on rooting of Domat and Ayvalik olive *Olea europaea* L. Cultivars in Shaded Polyethylene Tunnel (SPT). Tarim Bilimleri Dergisi, 11: 334-338.

Hartmann HT, Optiz KW, and Beutel AJ, 1980. Olive production in California. Division of Agricultural Sciences, University of California, Davis, Leaflet 2474:45.

Hartmann HT, Kester DE, Davies FT and Geneve RL, 2002. Plant propagation: Principles and practices, 7th ed. Prentice Hall Englewood Cliffs, New Jersey. pp. 880.

Hartmann HT, 1946. The use of root-promoting substances in the propagation of olives by soft- wood cuttings. Proc. Amer. Soc. Hort. Sci. 48:303-308.

Hechmi M, Khaled M, El- Hassen AS, Faiez AR and M'hamed A, 2013. Performance of olive cuttings (Olea *europaea* L.) of different cultivars growing in the agro-climatic conditions of Al-Jouf (Saudi Arabia). Am. J. of Plant Physiol. ISSN 1557-4539 L DOI: 10.3923/ajpp 1-9.

Hegab M MY, 2010. Physiological studies on rooting of easy and difficult to root olive cuttings. Minia J. of Agric. Res. & Develop. 30:397-411.

Isfendiyaroglu M, 2016. Root regeneration in cuttings of *olea europaea* L.: Effect of auxin and auxin sensitive phase. Bangladesh J. Bot. 45(2): 427-431. 16-Isfendiyaroglu M and Ozeker E, 2008. Rooting of *Olea europaea* 'Domat' cuttings by auxin and salicylic acid treatments. Pakistan J. Bot. 40(3): 1135-1140.

Isfendiyaroglu M and Ozeker E, and Başer S 2009. Rooting of 'Ayvalik' olive cuttings in different media. Spanish J. Agric. Res. **7**(1): 165-172.

Pio R, Costabastos D and Berti AJ, 2005. Rooting of different types of olive tree cutting using indol butyric acid. Cienc Agrotec Lavras 29:562-567.

Rahman N, Awan AA and Nabi G, 2002. Root initiation in hard wood cutting of olive cultivar corating using different concentration of IBA. Asian. J. Plant Sciences 1:563-564.

Sebastiani L and Tognetti R, 2004. Growing season and hydrogen peroxide effects on root induction and development in *Olea europaea* L. (cvs Frantoio and Gentil di Larino) cuttings. Scientia Horticulture 100: 75-82.

Serrason JM, Serrason MC, and Amaral E, 2002. Effect of different hormone treatments on rooting of olive. Acta Hort 586:875-877.

Sharma SDand Aier NB, 1989. Seasonal rooting behavior of cuttings of plum cultivars as influenced by IBA treatments. Sci Hortic 40: 297-303.

Turkoglu N and Durmus A, 2005. A study on root formation of four olive varieties by application of hormone. Asian J. Plant Sci 4: 455-457.

Vemmos N and Roussos P, 2012. The role of endogenous carbohydrates and seasonal variation in rooting ability of cuttings of an easy and a hard to root olive cultivars (*Olea europaea* L.) Sci Hortic 143: 19-28.

Wiesman Z and Lavee S, 1995. Enhancement of IBA stimulatory effect on rooting of olive cultivar stem cuttings. Scientia Hort. 62:189-198.

Wiesman Z and Markus A, 2002. Promotion of rooting and development of cutting by plant growth factors formulated in to a controlled release system. Biology and Fertility of Soils 36:330-334.