
# Effect of propagation dates, media and auxins treatments on rooting of Monterey cypress (*Cupressus macrocarpa*) semi-hard wood cuttings

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## Abstract

This experiment was carried out from 15th October, 2021 to 15th May, 2022 in the plastic house in Duhok city, Iraq. A study included the effect of three factors, the first one is two different propagation dates 15th October and 15th December, second one is three propagation media includes peat moss + perlite (1:1), sand + perlite (1:1) and peat moss + sand + perlite (1:1:1), and third one included three auxin concentrations includes (control, 3000 IBA+1500 NAA and 6000 IBA + 3000 mg. $L^{-1}$ NAA) on the rooting of *Cupressus macrocarpa* semi-hard wood cuttings. The results analyzed by (RCBD) design and indicated that the planting of cuttings at 15th October significantly gave the best results of all studied characters (rooting percentage (51.11%) and shoots characters) as compared with those date in 15th December which gave the lowest values. As for propagation media had significant effect only on rooting characters, the best results of rooting obtained when cuttings planted in both of (sand + perlite) and (sand + peat moss + perlite) media but the media hadn't any significant effects on shoot characters. Auxin treatment meaningfully affected on rooting ability of cuttings, high concentrations of auxins (6000 IBA+3000 NAA mg.$L^{-1}$) gave the best results of rooting characters comparison with low concentration (3000 IBA+1500 NAA mg.$L^{-1}$) and control (0 mg.$L^{-1}$) but hadn't any significant effects on shoots characters. Generally, the interaction among three factors showed that the planting of cutting treated with both concentrations of auxins in both of (sand + perlite) and (sand + peat moss + perlite) media at 15th October provided the best results of rooting percentage and improve most roots and shoots characters.

***Key worlds*:** propagation dates, media, auxins, *Cupressus macrocarpa* plant cuttings
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## Introduction

Monterey cypress (*Cupressus macrocarpa* 'Goldcrest Wilma') is an evergreen tree belong to cupressaceae family. It is generally famous as Monterey cypress or Lemon cypress, native to North America (California) [1] and [2]. Furthermore, it is an ornamental plant and a popular variant used in garden landscaping due to its eye-catching colors [3]. This species is also very resistant to salinity and temperature; it can withstand many unfavorable changes during its growth stages and is an excellent choice for seaside plantings. Although smaller cultivars such as 'Goldcrest' are grown in containers, it can be pruned to form a hedge [4].

The date or time of cuttings collection is the most important factors that can influence the rooting ability of stem cuttings of most ornamental trees and shrubs [5]. Time of cuttings collection play significance role in rooting success and cuttings development. This may be due to changes in the indigenous plant growth regulators or carbohydrate situation of cuttings and the environmental conditions present in nursery [6] and [7].

The factor, which creates a suitable environment for rooting of stem cuttings, is the propagation medium [8]. Propagation media can be defined as the mean where the roots of cultivated cutting grow [9]. It is often said that there are as many media as there are propagators, then there is no one best medium for all plants or all conditions [10]. The physical and chemical properties of the propagation medium have a significant impact on plant growth. Aeration and water holding capacity are probably the most important physical characteristics, while nutritional status and salinity level are critical chemical characteristics for plant development [11]. [12] stated that the combination of peat moss with perlite or sand is superior to other rooting media for rooting and growth of cuttings in some plants. [13] referred that the growing of *Cupressus macrocarpa* plants in a mixture medium containing (compost + perlite+ peat moss 1:1:1) produced the tallest plant, the highest values of fresh and dry weights of shoots, root length (cm), number of roots/plant, and fresh and dry weights of roots/plant in both seasons.

In difficult-to-root cuttings, root-promoting chemicals such as indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), and naphthalene acetic acid (NAA) stimulate the initiation of adventitious roots [10]. Exogenous auxins are commonly used to improve rooting efficiency and stem-cutting quality. (Indole-3-butyric acid) IBA and (1- napthaleneacetic acid) NAA promote adventitious rooting; auxins have been used as powerful agents to induce adventitious root formation in many species that are naturally difficult to root [14], and it reduces the time required to root stem cuttings [10]. Auxin (rooting hormones) are very important for plant propagation because they improve the quality of root system developed, root number, root length, root quality, decrease rooting time, and increase the percentage of cuttings that root [15].

There is no available information in the literature with respect to vegetative propagation by use of rooting media and auxin concentrations for induction of rooting of Cupressus species cuttings especially outside laboratories in Kurdistan region-Iraq; Therefore, the current study aimed to evaluating the rooting of Monterey cypress (*Cupressus macrocarpa*) semi hard-wood cuttings in response to two planting dates, propagation media and different mixed concentrations of IBA and NAA that will enhance successful establishment of the plant in nursery.

## Materials and Methods

The rooting response of Monterey cypress (*Cupressus macrocarpa*'Goldcrest Wilma') cuttings were planted at two different planting dates 15$^{th}$ October and 15$^{th}$ December, 2021, in three different propagation media includes peat moss + perlite (1:1), sand + perlite (1:1) and peat moss + sand + perlite (1:1:1). The harmony cuttings with length 10-12 cm with heel, cuttings were inserted in propagation media after treatment with different concentrations of auxins like Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) includes (control, 3000 IBA + 1500 NAA and 6000 IBA + 3000 mg.L$^{-1}$ NAA). Cuttings were planted in white plastic pots with size 25 cm that was filled with required

media and watered well before planting of cuttings.

The design of this experiment was factorial Randomized Complete Block Design (RCBD) with three factors. Each treatment replicated 3 times with 5 cuttings / pot for treatment. The studied measurements included rooting (%), number of roots per cutting, length of longest root (cm), dry weight of roots per cutting (g), number of shoots per cutting, length of longest shoots per cutting (cm), number of leaves per cutting, dry weight of shoots per cutting (g). The results have been analyzed statistically by using SAS program, means values were compared by Duncan test at 0.05 levels [16].

**Results and Discussions**

**1. Rooting percentage (%).**

The date in Table (4) indicated that the propagation date had a significant effected on the rooting percentage of *Cupressus macrocarpa* semi-hard wood cuttings and the highest percentage (51.11%) was planting at 15th October while the least percent was (41.85%) at 15th December. Also the propagation media had a significant effect on this parameter and the high percentage (52.78%) was when cuttings planted sand + perlite medium. The auxin at different concentrations had a significant effect on this parameter and the best percentage (72.78%) was for the high concentration 6000 IBA + 3000 NAA mg.l$^{-1}$ and compared with control which gave (3.33%). The triple interaction among the three factors (planting date, propagation media, and auxin concentrations) had a significant effect and the highest value 86.67 % was obtained from low and high concentration 3000 IBA + 1500 NAA mg.l$^{-1}$ and 6000 IBA + 3000 NAA mg.l$^{-1}$ respectively in sand + perlite medium at 15th October.

Table (1): Effect of propagation dates, media and auxins concentrations on the rooting percentage (%) of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.L$^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15th October | Peat moss+ Perlite | 0.00 d | 50.00 c | 60.00 bc | 51.11 a | |
| | Sand + perlite | 3.33 d | 86.67 a | 86.67 a | | |
| | Sand + peat moss + perlite | 6.67 d | 83.33 a | 83.33 a | | |
| 15th December | Peat moss+ Perlite | 0.00 d | 53.33 c | 73.33 ab | 41.85 b | 39.44 b |
| | Sand + perlite | 6.67 d | 53.33 c | 80.00 a | | 52.78 a |
| | Sand + peat moss + perlite | 3.33 d | 53.33 c | 53.33 c | | 47.22 a |
| Auxins concentrations means | | 3.33 c | 63.33 b | 72.78 a | | |

Means with same letter for each factor and interaction are not significantly different at 5% level based on Duncan's Multiple Rang Test.

**2. Roots number per cutting**

Table (2) indicated that the propagation date had a significant effect on the root number formation on the cuttings and the highest significant number (5.06 roots) was when planting at 15th October as compared with least number of roots (3.53) at 15th December. The propagation media also had a significant effect on this parameter and the highest number of roots (5.82) was when planting cuttings in media consist of sand + perlite. The auxin concentrations had a significant effect on this parameter and the highest number were (7.97) roots for the high concentration (3000 IBA + 6000 NAA mg. L$^{-1}$) compared with control which gave (0.56) root/cutting. The triple interaction among the three had a significant effect and the highest value (13.07) roots per cuttings was obtained when treated cuttings with high concentration 3000 IBA + 6000 NAA mg. Ll$^{-1}$ and planted in sand + perlite and peat moss +sand + perlite media respectively at 15th October.

Table (2): Effect of propagation dates, media and auxins concentrations on the roots number per cutting of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.L$^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15$^{th}$ October | Peat moss+ Perlite | 0.00 e | 1.67 de | 3.53 c-e | 5.06 a | |
| | Sand + perlite | 0.67 de | 4.87 b-d | 13.07 a | | |
| | Sand + peat moss + perlite | 1.67 de | 7.20 bc | 12.87 a | | |
| 15$^{th}$ December | Peat moss+ Perlite | 0.00 e | 2.73 c-e | 4.47 c-e | 3.53 b | 2.07 b |
| | Sand + perlite | 0.67 de | 6.53 bc | 9.13 ab | | 5.82 a |
| | Sand + peat moss + perlite | 0.33 de | 3.13 c-e | 4.73 b-e | | 4.99 a |
| Auxins concentrations means | | 0.56 c | 4.36 b | 7.97 a | | |

**3. Length of longest root (cm)**

Table (3) indicate to presence of significant difference between two propagation date on length of longest root/cutting, the superior value was (7.10) cm for cuttings planted in 15$^{th}$ October in comparison to 15$^{th}$ December which gave shorter root length (4.14 cm). As for auxin concentrations which had significant effect on this parameter and the best length (9.26 cm) was for the high concentration (3000 IBA + 6000 NAA) mg. L$^{-1}$ compared with low concentration and control treatment which gives 6.98 and 0.61cm respectively. When cuttings planted in media consisted of peat moss + sand + perlite (1:1:1) caused meaningful increase in length of longest root per cutting which reached (7.54 cm) while lower length value (5.37 and 3.93 cm) were found for the other two media sand + perlite (1:1) and peat moss + perlite (1:1) respectively. The triple interaction among the three factors had a significant effect and the highest value of longest root (16.33 cm) obtained when treated cuttings with high auxin concentration 3000 IBA + 6000 NAA mg. L$^{-1}$ and planted in peat moss + sand + perlite medium at 15$^{th}$ October.

Table (3): Effect of propagation dates, media and auxins concentrations on length of longest root per cutting (cm) of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.L$^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15$^{th}$ October | Peat moss+ Perlite | 0.00 g | 4.00 d-g | 7.90 cd | 7.10 a | |
| | Sand + perlite | 0.67 fg | 7.97 cd | 10.63 bc | | |
| | Sand + peat moss + perlite | 2.00 e-g | 14.37 ab | 16.33 a | | |
| 15$^{th}$ December | Peat moss+ Perlite | 0.00 g | 4.07 d-g | 7.63 cd | 4.14 b | 3.93 b |
| | Sand + perlite | 0.67 fg | 4.93 d-g | 7.37 c-e | | 5.37 b |
| | Sand + peat moss + perlite | 0.33 fg | 6.57 c-e | 5.67 c-f | | 7.54 a |
| Auxins concentrations means | | 0.61 c | 6.98 b | 9.26 a | | |

**4. Dry weight of roots (g)**

It can be shown from results in Table (4) that the planting of *Cupressus macrocarpa* semi-hard wood cuttings in 15$^{th}$ October caused an increase in dry weight of roots (0.46 g) which was different significantly over those planting in 15$^{th}$ December (0.14 g). Likewise there was significant difference among various auxin concentrations on dry weight of shoots with (0.57 g) being the superior weight which obtained from 6000 IBA + 3000 NAA mg.l$^{-1}$ when compared with other treatments particularly with control which obtained lower weight (0.00 g). The propagation media had a significant effect on

this parameter and the highest dry weight of roots (0.38 g) was when planting cuttings in media consist of sand + peat moss + perlite. The best dry weights (1.02 and 0.91 g) were shown from triple interaction cuttings treated with 6000 IBA + 3000 NAA mg. $L^{-1}$ and planted in media consist of sand + peat moss + perlite and sand + perlite at 15th October respectively.

Table (4): Effect of propagation dates, media and auxins concentrations on roots dry weight (g) of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.$L^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15th October | Peat moss+ Perlite | 0.00 c | 0.10 c | 0.71 ab | 0.46 a | |
| | Sand + perlite | 0.00 c | 0.71 ab | 0.91 a | | |
| | Sand + peat moss + perlite | 0.00 c | 0.73 ab | 1.02 a | | |
| 15th December | Peat moss+ Perlite | 0.00 c | 0.15 c | 0.12 c | 0.14 b | 0.18 b |
| | Sand + perlite | 0.00 c | 0.05 c | 0.38 bc | | 0.34 ab |
| | Sand + peat moss + perlite | 0.00 c | 0.30 bc | 0.25 bc | | 0.38 a |
| Auxins concentrations means | | 0.00 c | 0.34 b | 0.57 a | | |

**5. Shoots number**

Table (5) shows clarify meaningful difference between propagation dates on shoots number per cutting, maximum shoots number (13.19) shoots were found on cuttings grown in 15th October which was significantly different from those found on cuttings planted in 15th December which provided only (11.20) shoots per cutting. As well, when cuttings planted in sand + perlite (1:1) medium produced the significant highest shoots number (13.02) compared with the lowest number (211.06) shoots for cuttings planted in Peat moss + perlite (1:1) medium. Different auxins concentrations hadn't caused considerable variation on shoots number. The maximum shoots number (17.20) shoots were noticed from triple interaction from untreated cuttings with auxins concentrations (control) and planted in sand + perlite (1:1) medium on 15th October, in contrast, the lowest number (9.20) shoots were showed for untreated cuttings with auxin and planted in sand + seat moss + perlite (1:1:1) medium on 15th December.

Table (5): Effect of propagation dates, media and auxins concentrations on shoots number per cutting of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.$L^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15th October | Peat moss+ Perlite | 10.40 bc | 11.13 bc | 10.73 bc | 13.19 a | |
| | Sand + perlite | 17.20 a | 14.93 ab | 13.07 abc | | |
| | Sand + peat moss + perlite | 13.00 abc | 12.93 abc | 15.33 ab | | |
| 15th December | Peat moss+ Perlite | 11.20 bc | 11.53 bc | 11.33 bc | 11.20 b | 11.06 b |
| | Sand + perlite | 11.07 bc | 10.53 bc | 11.33 bc | | 13.02 a |
| | Sand + peat moss + perlite | 9.20 c | 12.87 abc | 11.73 bc | | 12.51 ab |
| Auxins concentrations means | | 12.01 a | 12.32 a | 12.26 a | | |

**6. Length of longest shoot (cm)**

It can be pointed out from recorded data in table (6) that length of longest shoot per cutting significantly decreased from the first planting date 15th August which provided longest shoot length (2.00 cm) toward the last planting date 15th October which showed

lowest (1.23 cm). Both of propagation media and auxins concentrations hadn't significant effects on shoots number. From interaction among all three studied factors on their effect on length of longest shoots per cutting, it is obvious that (6.93 cm) longest shoots length/cutting were found on cuttings treated with 3000 IBA + 1500 NAA mg. $L^{-1}$ and planted in sand + perlite (1:1) medium at 15th October in comparison with (4.87 cm) lowest length cuttings treated with same auxin concentrations and planted in same medium at 15th December.

Table (6): Effect of propagation dates, media and auxins concentrations on length of longest shoot per cutting (cm) of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.$L^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15th October | Peat moss+ Perlite | 6.13 a-d | 6.27 a-d | 6.43 a-c | 6.15 a | |
| | Sand + perlite | 6.90 ab | 6.93 a | 5.47 a-d | | |
| | Sand + peat moss + perlite | 5.57 a-d | 5.63 a-d | 5.98 a-d | | |
| 15th December | Peat moss+ Perlite | 4.80 d | 5.63 a-d | 4.90 d | 5.34 b | 5.69 a |
| | Sand + perlite | 5.13 cd | 4.87 d | 6.00 a-d | | 5.88 a |
| | Sand + peat moss + perlite | 5.41 a-d | 5.90 a-d | 5.40 a-d | | 5.65 a |
| Auxins concentrations means | | 5.66 a | 5.87 a | 5.70 a | | |

**7. Leaves number per cutting**

Concerning the results available in Table (7) on effect of studied factors on leaves number, it can be shown the significant highest leaves number per cutting (11.44) leaves from planted cuttings in 15th October, compared with lowest (3.85) leaves on those cuttings planted 15th December. Both of propagation media and auxins concentrations hadn't significant effects on leaves number per cutting. From interaction among all three studied factors on their effect on length of longest shoots per cutting. As for triple interaction The maximum leaves number (12.93) leaves were noticed from cuttings planted at 15th October in sand + peat moss medium and treated with 3000 IBA + 1500 NAA mg. $L^{-1}$ in contrast with lowest number (8.53) leaves per cuttings treated with same auxin concentrations and planted in same medium at 15th December.

Table (7): Effect of propagation dates, media and auxins concentrations on leaves number per cutting of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.$L^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15th October | Peat moss+ Perlite | 12.53 a | 11.33 ab | 11.20 ab | 11.44 a | |
| | Sand + perlite | 12.67 a | 12.93 a | 9.67 ab | | |
| | Sand + peat moss + perlite | 11.27 ab | 10.40 ab | 10.93 ab | | |
| 15th December | Peat moss+ Perlite | 10.33 ab | 10.27 ab | 9.20 ab | 10.12 b | 10.81 a |
| | Sand + perlite | 10.40 ab | 8.53 b | 10.93 ab | | 10.86 a |
| | Sand + peat moss + perlite | 10.00 ab | 11.27 ab | 10.13 ab | | 10.67 a |
| Auxins concentrations means | | 11.20 a | 10.79 a | 10.34 a | | |

**8. Dry weight of shoots (g)**

The results of dry weight of roots in Table (8) appear that the significant highest shoot dry weight (5.66 g) were clarified from shoots grown on cuttings planted in 15th October, while this value gradually decreased toward (4.65 g) being the lowest shoots dry weight

value which found from produced shoots on cuttings planted in 15th October. Both of propagation media and auxins concentrations hadn't significant effects on shoot dry weight. From triple interaction among planting dates, propagation media, and auxin treatment it can be shown that when cuttings planted at 15th October in each of sand + peat moss + perlite and sand + perlite media and treated with 3000 IBA + 1500 NAA mg. $L^{-1}$ provided significantly highest shoots dry weight (6.92 and 6.88 g) respectively.

Table (8): Effect of propagation dates, media and auxins concentrations on shoots dry weight (g) of *Cupressus macrocarpa* semi-hard wood cuttings.

| Propagation dates | Propagation media | Auxins concentrations (IBA + NAA mg.$L^{-1}$) | | | Propagation dates means | Propagation media means |
|---|---|---|---|---|---|---|
| | | 0 | 3000 + 1500 | 6000 + 3000 | | |
| 15th October | Peat moss+ Perlite | 5.01 a-c | 5.03 a-c | 3.74 c | 5.66 a | |
| | Sand + perlite | 6.64 ab | 6.88 a | 5.02 a-c | | |
| | Sand + peat moss + perlite | 6.15 a-c | 6.92 a | 5.61 a-c | | |
| 15th December | Peat moss+ Perlite | 4.51 a-c | 4.08 bc | 5.40 a-c | 4.65 b | 4.63 a |
| | Sand + perlite | 5.48 a-c | 5.27 a-c | 4.33 a-c | | 5.60 a |
| | Sand + peat moss + perlite | 3.81 c | 4.97 a-c | 3.99 bc | | 5.24 a |
| Auxins concentrations means | | 5.27 a | 5.53 a | 4.68 a | | |

As it is demonstrated in effect of propagation dates in Tables (1-8) significant difference from effect of planting date were showed in all studied characteristics. The planting of cuttings at 15th October significantly gave the best results of all studied characters included rooting percentage 51.11%, roots number per cuttings, longest root, roots dry weight, shoot number, longest shoot per cutting, leaves number and shoots dry weight as compared with those planted in 15th December which gave the lowest values. This may be correlated to the presence of suitable temperature degree during this date, temperature is one of the effective factors on rooting of cuttings, an increase in proper temperature cause promotion of cuttings to form roots and absorb nutrient elements from media [17], also the decrease in temperature in winter may cause increase in production of inhibitors which in turn decrease roots formation [18] this may be the reason of lower rooting in December, these were in correspond with results [19] mentioned that planted stem cuttings of *Platanus orientalis* in October revealed best roots number and [20] which found better roots number from planted terminal stem cuttings of *Conocarpus lancifolius* in October than in September, the reason might be from great impact of physiological state, carbohydrate amount exist in cuttings and the environmental conditions prevailing during season of the year [21[. [22] explained this fact on a basis that formation of roots on cuttings leads to absorption of water and nutrient elements from medium which results stimulation of production good shoots system on cuttings. Also may discuss on the base that roots form cytokinin and this have a role in promoting shoots formation by ending apical dominance [23]. or may be due to the formation of shoots on cuttings of this date before formation of roots because of proper environmental conditions and with production of roots on these cutting which are considered a good source of cytokinins production, it provide a stimulation role on enhancing growth of buds on cuttings and according to [24] when roots form on cuttings it prepare the required water and nutrient element to shoots for their growth and development. As obvious heaviest dry weight of shoots was found in first planting date 15th October, it might be due to presence of maximum results of shoots number, length of longest shoot and leaves number of this date which contributed to get best shoots dry weight.

From results available in tables (1-4) significant variation can be observed from effect of used propagation media on all rooting characters, but hadn't any significant

effect on vegetative growth characters as in Tables 6-8) except shoots number per cutting (Table 5) which affected significantly by media, generally sand + perlite and sand + peat moss + perlite provide better results than medium composed of peat moss + perlite or the media which contain sand gave best results for rooting characters where sand is known as have low retention to water, quickly dry [10], and have poor fertility, load fewer and leach most nutrients [25], but when sand is supplied with some organic products it can give better results [26]. Propagation media are considered as place where roots of planted cutting grow and act to provide necessary nutrient elements, water and oxygen [27]. Formation of roots on cuttings is greatly influenced by physical and chemical properties of propagation medium such as (porosity, water-holding capacity, bulk density, pH, etc.) which permit stimulating or preventing root growth [10]. Propagation medium not only influence on rooting percentage of cuttings but also the quantity and quality of produced roots [28]. And when added peat moss to any other medium it enhances its physical properties such as water retention and porosity [29]. It has the ability of absorb water eight times more than its weight in saturation stage around roots area and therefore cause increase in availability of nutrient elements in medium [30], it consist of phosphate's and nitrogenous compounds that contribute in rooting process, as the importance of nitrogen is related to the formation of amino acids, proteins and amino acids RNAs therefore it play a role in different process that cause cells division and formation of new cells [31], or may be due to existence of appropriate physical circumstances and suitable nutrients in medium which enhanced enzymatic activating and biochemical processes in cuttings [32] and thereby increasing shoots number.

Treatment of cuttings with auxins concentrations as seen in Tables (1-4) caused a significant difference over control treatment. Highest rooting percentage, roots number per cuttings, length of longest roots per cutting and dry weight of roots was observed from cutting treated with high concentration of auxins treatment (6000 IBA + 3000 NAA) followed by low concentration (3000 IBA + 1500 NAA mg. $L^{-1}$ as compared with control, but hadn't significant effects on all shoots as in Tables (5-8). A considerable increase of rooting percent and other roots characters which showed from cuttings treated with high concentration of auxin this might be from the influence of auxin on metabolites accumulation at the applied site, synthesis of new proteins, formation of callus, division of cells and enlargement of cell [33]. Highest length of root per cutting as clear in table (3) which noticed in mean of 6000 IBA + 3000 NAA mg. $L^{-1}$, length of root is increased at the utilization of specific concentration auxin, because auxins promoted and regulated elongation of roots by organization the elongation of cell process and by control on formation of certain type of RNA, which in turn get the code of syntheses particular enzymes and the action of locking specialized cell to the elongation process [34].

## Conclusions

The experimental results lead us to the conclusion that the planting of Monterey cypress (*Cupressus macrocarpa*) semi-hard wood cuttings in 15$^{th}$ October gave best results of rooting percentage, roots and shoots characters than those planted at 15$^{th}$ December. As for propagation media noticed that the best results obtained when cuttings planted in both of sand + perlite and sand + peat moss + perlite than medium composed of peat moss + perlite or the media which contain sand gave best results for rooting characters but hadn't significant effects on vegetative growth character. Treatment of cuttings with auxin meaningfully affected on rooting ability of cuttings at high concentration (6000 IBA + 3000 NAA mg. $L^{-1}$) comparison with low concentration (3000 IBA + 1500 NAA mg. $L^{-1}$) and control (0 mg. $L^{-1}$) but hadn't any significant effects on vegetative growth character. Generally, planting of cuttings treated with auxin in both of (sand + perlite) and (sand + peat moss + perlite) media at 15$^{th}$ October provided the best results of rooting percentage and improve most of roots and shoots characters.

## References


[1] Graf, A.B., (1992). Hortica: Color Cyclopedia of Garden Flora and Indoor Plants .1st Ed. Roehs Company Puplisher. U.S.A. 1216

[2] Thukral, S.K.; Sumitra, S. and Surendra,K.S. (2014). Pharmacognostical standardization of leaves of *Cupressus macrocarpa* Hartweg. ex Gordon. J. Appl. Pharm. Sci., 4: 71- 74.

[3] Cabrera, J., Martínez, F. and Granada, L. (2007). Producción de Cedro Limón *Cupressus macrocarpa* Goldcrest en Morelos. Folleto Técnico 29. Secretaria de Agricultura, Ganadería. Desarrollo rural, Pesca y Alimentación. INIFAP. Morelos–México, pp.2-8.

[4] Luis, G.C., Julián, C.R., Flavio, M.M. (2007). Producción de cedro limón *Cupressus macrocarpa* goldcrest en Morelos.

[5] Chojnowska, E. (2004). The effect of cutting dates, temperature and different rooting stimulators on the rooting of cuttings of *Aubrieta cultorum*. Electronic Journal of Polish Agricultural Universities, 7 (2).

[6] Abdou, M.A., Mohamed, M.A.H. and Attia, F.A. (2004). Physiological studies on *Ficus benjamina* plants. 1: Effect of cutting collection. IBA and nofatrein on chemical composition, root ability of cutting and transplants growth. Journal of Agricultural Science, Mansoura Univ., 29 (2): 775-785.

[7] Elgimabi, M.E.N.E. (2008). Effect of season of cutting and humidity on propagation of (*Ixora coccinea*). Advances in Biological Research 2 (5-6): 108-110.

[8] Laubscher, C. P. and Ndakimedi, P. A. (2008). The effects of Indole Acetic Acid and rooting mediums on rooting of *Leucaden dronlaxum* (Proteaceae) in a shed tunnel environment. *Am. Euras. J. Agric & Environ. Scie.* 4, 326 – 331.

[9] Kampf, A. N. (2000). The substrate Commercial production of ornamental plants. Guaíba: Agriculture, p. 254.

[10] Hartmann, H. T., Kester, D. E., Davies, F. T. Jr. and Geneve, R. L. (2014). Plant Propagation: Principles and Practices. 7th ed. Prentice Hall. Upper Saddle River, NJ.

[11] Dewayne, L.I., Richard, W.H. and Thomas, H.Y. (2003). Growth Media for Container Grown Ornamental Plants. The Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, BUL241.

[12] Jaleta, A. and Sulaiman, M. (2019). A review on the effect of rooting media on rooting and growth of cutting propagated grape (*Vitis vinifera* L.). World J. Agric. Soil Sci., 3(4):1- 8.

[13] Youssef, A. S. M.; Ghatas, Y.A.A. and Awaad, M.M.M. (2020). Effect of Planting Media and Fertilization Treatments on Growth and Chemical Composition of Cupressus Macrocarpa L. Plant. Annals of Agric. Sci., Moshtohor Vol. 58(3), 599 – 614.

[14] Dirr, M. A. and Heuser, C. W. Jr. (1987). The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Varsity Press, Inc., Athens, GA.

[15] Salman, M.A. (1988). Horticulture Plants Propagation. Dar-Alkutub for publishing and pressing, Iraq. Mosul Univ. (In Arabic).

[16] SAS. (2001). Statistical Analysis System. SAS Institute Inc., Cary, Nc. USA.

[17] Davies, T.D., Haissig, B.E. and Sankhla, N. (1988). Adventitious root formation in cutting. Dio Scorides press, Portland, USA.

[18] Singh, K.K., Jat, D.K. and Mehta, S.K. (2015). Root ability of hardwood cuttings of mulberry (*Morus alba* L.) influenced by planting time and growing conditions under valley condition of Garhwal Himalayas. Plant Archives, 15 (2): 1031-1036.

[19] Zencirkiran, M. and Erken, K. (2012). The effect of different times collecting cutting and auxin treatments of the rooting in *Platanus orientalis* L. (Oriental plane tree - Cinar).the journal of animal & plant sciences, 22 (3): 764-767.

[20] Al-Tohafy, S.A.A., Lateef, A.A. and Abdulraheem, H.A. (2014 a). Effect of cuttings type, Planting date and treatment of Indol Butric Acid (IBA) on Rooting of Cuttings and Vegetative Growth Properties of Damas (*Conocarpus lancifolius*) for summer season. *Euphrates Journal of Agriculture Science*, 6 (2): 1-11. (In Arabic)

[21] Babaie, H., Zarei, H. and Hemmati, K. (2014). Propagation of *Ficus benjamina* var. starlight by stenting technique under different concentrations of IBA in various times of taking cutting. Journal of Ornamental Plants, 4 (2): 75-79.

[22] Hartmann, H.T., Kester, D.E., Davis, F.T., Jr. and Geneve, R.L. (2002). Hartmann and Kester's Plant Propagation: Principles and Practices. Seventh edition. Prentice Hall, Upper Saddle Loamy, N.J. USA.

[23] Al-Mizory, H.S.F and Bashy B.Z.A.K. (2006). Effect of Planting dates and different concentrations of Indole butyric Acid (IBA) on the rooting of cuttings of *Carissa grandiflora*. Mesopotamia Journal of Agriculture, 34 (4): 38-48. (In Arabic)

[24] Abdlqader, H.A. (1999). Effect of pinching and use of benzyl adenine on shooting and rooting of Dracaena fragrance shoots. Master thesis, agriculture and forestry College-Mosul University.

[25] Osman, K.T. (2012). Soils: principles, properties and management. Springer Science & Business Media.

[26] Bender, O.D. and Nedim, O. (2007). The effect of hazel nut husk compost and some organic and inorganic media on root growth of kiwifruit (*Actinidia deliciosa*). *Journal of Agronomy*, 6: 113-118.

[27] Handreck, K. and Black, N. (2005). Growing media for ornamental Plants and turf. University of New South Wales Press Ltd, Sudan, Australia.

**[28] Dolor, D.E., Ikie, F.O. and Nnaji, G.U. (2009).** Effect of propagation media on the rooting of leafy stem cuttings of *Irvingia wombolu*

(Vermoesen). *Research Journal of Agriculture and Biological Sciences*, 5 (6): 1146-1152.

[29] Nyamangara, J., Gotosa, J. and Mpofu, S.E. (2001). Cattle manure effects on structural stability and water retention capacity of a granitic sandy soil in Zimbabwe. Soil and Tillage Research. 62: 157-162.

[30] Hahn, E.j., Jean, M.W. and Peak, K.Y. (2001). Culture method and growing medium affect growth and flower quality of several Gerbra cultivars . Acta Horticulturae, 548 : 385-392

[31] Wiesman, Z. and Lavce, S. (1995). Relationship of Carbohydrate sources and Indole-3-butyric acid in Olive. Aust. J. plant physiol. 22 (5): 811-816.

[32] Wazir, M.G., Amin, N.U. and Ishtiaq, M. (2003). Effects of different potting mixtures and nitrogen source on the performance of Brassaia seedlings-I. Sarhad J. Agri., 19: 463–8.

[33] Villar, M. and Gaget –Faurobert (1997). Mentor, effects in pistil mediated pollen - pollen interactions Cambridge University Press, New York, pp. 315-332. 81.

[34] Salih, M.M.S. (1991). Physiology of plant growth regulators. Ministry of Higher Education and Scientific Research, University of Salahuddin.

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# تأثير مواعيد واوساط الاكثار ومعاملات الاوكسينات في تجذير العقل نصف الخشبية لنبات السرو الليموني *Cupressus macrocarpa*

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**الملخص**

اجريت هذه الدراسة للفترة من 15 تشرين الاول ، 2021 الى 15 ايار، 2022 في البيت البلاستيكي في محافظة دهوك، اقليم كردستان العراق. تضمنت الدراسة تاثير موعدين للزراعة وهي 15 تشرين الاول و 15 كانون الاول، ثلاث اوساط اكثار تشمل البيت موس + البرلايت (1:1) ، الرمل + البرلايت (1:1) و البت موس + الرمل + البرلايت (1:1:1) وثلاثة تراكيز مختلفة من الاوكسين تتضمن (معاملة المقارنة، IBA 6000 + NAA 3000 و IBA 3000 + NAA 1500 ملغم لتر$^{-1}$) في تجذير العقل نصف الخشبية لنبات السرو الليموني Cupressus macrocarpa. اهم النتائج تشير بان زراعة العقل في 15 تشرين الاول اعطت افضل النتائج المعنوية لجميع صفات الدراسة مقارنة بالزراعة في 15 كانون الاول والتي اعطت اقل القيم للصفات المدروسة. اما لاوساط الاكثار لوحظت بانها قد اثر معنويا فقط في صفات التجذير وان افضل التالئج نسبة تجذير قد حصلت من العقل التي زرعت في الوسطين (رمل + برلايت) و (رمل + بيت موس + برلايت) بل لم يكن للاوساط اي تاثير معنوي في صفات النمو الخضري. معاملة الاوكسين ايضا قد اثر معنويا في قابلية العقل للتجذير حيث التراكيز العالية من الاوكسينات 6000 IBA+ 3000 NAA ملغم لتر$^{-1}$ قد اعطت افضل النتائج لصفات التجذير مقارنة بالتراكيز الواطئة و IBA 3000 + 1500 NAA ملغم لتر$^{-1}$ ومعاملة المقارنة ولم يكن للاوكسين اي تاثير معنوي في صفات النمو الخضري. بشكل عام ان زراعة العقل المعاملة بالتراكيز المختلفة من الاوكسنات في الوسطين الوسطين (رمل + برلايت) و (رمل + بيت موس + برلايت) عند الموعد 15 تشرين الاول قد زودت احسن النتائج لنسبة التجذيروتحسين مواصفات الجذور والتمو الخضري.

**الكلمات المفتاحية:** مواعيد الاكثار، الاوساط، الاوكسينات، عقل نبات *Cupressus macrocarpa*